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**Datasheet for the decision  
of 17 July 2007**

**Case Number:** T 0016/05 - 3.3.05

**Application Number:** 97937577.1

**Publication Number:** 0949961

**IPC:** B01J 8/22

**Language of the proceedings:** EN

**Title of invention:**

Process and reactor for carrying out an exothermic reaction

**Patentee:**

SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

**Opponent:**

SASOL Technology (Pty) Ltd.  
Exxon Mobil Research and Engineering Company

**Headword:**

Fischer-Tropsch synthesis/SHELL

**Relevant legal provisions:**

EPC Art. 123(2), 100(b), 84, 56

**Keyword:**

"Amended subject-matter clearly and unambiguously disclosed  
(yes)"

"Amended claims supported by amended description (yes)"

"Sufficiency of disclosure (yes)"

"Inventive step (yes)"

**Decisions cited:**

G 0001/93, T 0256/87, T 0925/98, T 0686/99

**Catchword:**

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Case Number: T 0016/05-3.3.05

**D E C I S I O N**  
**of the Technical Board of Appeal**  
**of 17 July 2007**

**Appellant:** Exxon Mobil Research and Engineering Company  
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**Respondent:** SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.  
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**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
2 November 2004 concerning maintenance of the  
European Patent No. 0949961 in amended form.

**Composition of the Board:**

**Chairman:** M. Eberhard  
**Members:** B. Czech  
S. Hoffmann

## Summary of Facts and Submissions

I. The appeal is from the decision of the opposition division concerning the maintenance of European patent No. 0 949 961 in amended form.

II. In the opposition proceedings, the opponents considered the claimed subject-matter to lack novelty and inventive step. Their objections were based inter alia on the following prior art documents:

A1: US-A-2 775 512

A2: US-A-4 408 024

D1: M.D. Schlesinger, J. H. Crowell, M. Leva, and H.H. Storch, Industrial and Engineering Chemistry, 1951, Volume 43, pages 1474 - 1479.

D3: H. Kölbel and P. Ackermann, Hydrogenation of Carbon Monoxide in Liquid Phase, Proceedings Third World Petroleum Congress, Section IV, 1951.

D4: Liquid Phase Fischer-Tropsch (II) Demonstration in the Laporte Alternative Fuels Development Unit, Air Products and Chemicals, Bharat L Bhatt, September 1995, prepared for US DoE

D5: US-A-2 584 391

Opponent 2 had also filed

L1: A first letter of Prof. Deckwer to Mr. Northover dated 29 July 2004

L2: A second letter of Prof Deckwer to Mr. Northover dated 23 September 2004

III. In the contested decision, the opposition division held that the amended patent comprising the claims according to the fourth auxiliary request then on file, as well as an amended description, met the requirements of the EPC. Independent claims 1 and 3 of the said request read as follows:

*"1. A process for carrying out an exothermic reaction in the presence of solid catalyst particles in a three-phase slurry reactor comprising a slurry zone and a freeboard zone, in which slurry zone the catalyst particles are kept in suspension in a slurry liquid, which freeboard zone contains catalyst particles escaped from the slurry zone, which exothermic reaction produces at least some gaseous products, which gaseous products are capable of at least partly condensing at a temperature between the reaction temperature in the top part of the slurry zone and 50 °C below the said reaction temperature, and in which freeboard zone a liquid reflux is maintained to remove the catalyst particles from the freeboard zone, wherein the gaseous product is at least partly condensed in the freeboard zone to generate the liquid reflux and wherein the gaseous products are at least partly condensed by indirect cooling means in the freeboard zone, the slurry zone being cooled by indirect cooling means, the exothermic reaction being the Fischer-Tropsch reaction, using a cobalt catalyst and using a superficial gas velocity of syngas in the range from 5 to 50 cm/sec, wherein the freeboard zone contains means to trap catalyst particles, or wherein the freeboard zone contains means to trap catalyst particles comprising one or more corrugated plates and a liquid reflux is maintained over the corrugated plates."*

*"3. A three-phase slurry reactor for carrying out exothermic reactions in the presence of a catalyst, comprising reactant inlet means and product outlet means, a slurry zone equipped with cooling means, and a freeboard zone, wherein the freeboard zone contains means to trap catalyst particles, wherein the reactor is adapted to maintain a liquid reflux in the freeboard zone, wherein the means to trap catalyst particles comprises a plurality of corrugated plates containing a plurality of corrugations, which corrugated plates are arranged substantially vertical and substantially parallel to the overall direction of flow of the gases through the trap, and wherein operation the crests of the corrugations force the gases to follow a tortuous path through the trap."*

More particularly, the opposition division considered that the process of claim 1 involved an inventive step in view of the disclosure of A2 or of a combination of the disclosures of D4, taken as the closest prior art, and D5. The reactor of claim 3 was not obvious in view of A2.

IV. With its statement of grounds of appeal, the appellant (opponent 2) filed the following document:

P1A: "Bubble Column Reactors", W.-D. Deckwer,  
Wiley, 1992 title page, copyright page, and pp  
255-260.

V. Together with its reply, the respondent (proprietor of the patent) also filed a further amended set of claims as first auxiliary request. With a further letter dated 15 June 2007, the respondent re-filed the claims according to its previous main and first auxiliary

requests and filed four additional sets of claims as second to fifth auxiliary requests.

- VI. Oral proceedings took place on 17 July 2007 in the absence of the duly summoned opponent 1.
- VII. The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed, or, in the alternative, that the patent be maintained on the basis of the claims according to one of the first to fifth auxiliary requests filed with its letter dated 15 June 2007.

Opponent 1 did not present any request during the appeal proceedings.

- VIII. As far as they concern the claims and description according to the main request, the essential arguments of the parties can be summarised as follows:

The appellant argued that amended claim 1 contravened Article 123(2) EPC. It did not only contain features from the claims of the published PCT application WO 98/06487 A1 ("the PCT application" hereinafter) but also additional limitations taken from different passages of the description and relating to the use of "*indirect cooling means in the freeboard zone*" (emphasis added by the board) which was said to be disadvantageous, to the use of indirect cooling means in the slurry zone, to the use of a cobalt catalyst, and to a gas velocity range not even disclosed as such. Multiple selections had to be made to arrive at the

claimed combination of features. Referring also to decisions T 0686/99 of 22 January 2003 (not published in OJ EPO) and G 0003/89 (OJ EPO 1993, 117), it submitted that the subject-matter of the amended claims was not directly and unambiguously derivable from the PCT application and thus provided an unwarranted advantage to the respondent.

At the oral proceedings, the appellant expressly confirmed that its objections under Article 84 EPC raised in writing concerned the lack of support of claim 1 in view of inconsistencies between the wording of this claim and the wording of the amended description sections [0020] and [0049]. Some features were mandatory according to the latter, but not according to claim 1.

On the other hand these discrepancies left the skilled reader with several quandaries as to how the invention was to be performed. In particular, the reader of the patent did not know what the bounds of the invention were, since it did not know whether or not the slurry cooling means could extend into the freeboard zone, whether or not corrugated plates were required, and what the bounds of the freeboard zone were, i.e. whether or not the reactor wall belonged to the freeboard zone. Referring to decision T 0256/87 of 26 July 1988 (not published in the OJ EPO), it concluded that the patent as amended was objectionable under Article 100(b) EPC.

In writing, the appellant argued that D4 was the closest prior art and that walls of the reactor described in D4 constituted indirect cooling means in the freeboard zone and also acted as means to trap catalyst particles. Referring to D3, A1, L1 and L2, it

considered that the technical problem was merely to provide an alternative process and reactor. Since D4 disclosed each feature of claim 1, there was no inventive step in combining them. If some catalyst sticking did arise upon operation of the reactor of D4, this problem could be solved by applying the teaching of A1 or of D5. Adding additional indirect cooling means would be obvious in view of D1 or A2. At the oral proceedings, the appellant additionally held that even should the features "*internal cooling means in the freeboard zone*" and "*wherein the freeboard zone contains means to trap particles*" be considered to establish a difference over the disclosure of D4, the process of claim 1 would be obvious in view of a combination of D4 with D5. D5 disclosed a separator for returning catalyst particles to a reactor wherein catalyst particles were fluidised by gases or liquids. The device for separating the catalyst particles according to D5 would also be cooled since it partly stuck out of the hot reactor. Moreover, upon being questioned by the board at the oral proceedings, the appellant submitted that the alternative process of claim 1 involving corrugated plates and the reactor according to claim 3 were also not inventive in view of a combination of D4 with D5 since they were merely obvious engineering alternatives providing no improvement or benefit. Since the use of a trap was obvious, the use of such a more specific trap was also obvious.

The respondent considered that the amendments to claim 1 were all based on the PCT application. It emphasised that the features introduced into claim 1 were preferred ones according to the description and



the figures of the PCT application, and referred also to decision T 0925/98 of 13 March 2001 (not published in the OJ EPO).

Pointing to sections [0007], [0015], [0016], [0018], [0019], [0007], [0047] and [0048] of the amended description, the respondent took the view that amended claim 1 was supported by the amended description since there were no discrepancies between the amended description and claim 1. The scope of the claims was clear from the wording and order of the claims and the description, and the objection under Article 100(b) EPC had not been substantiated.

The respondent argued that D4 neither disclosed nor suggested indirect cooling means in the freeboard zone nor means to trap entrained catalyst particles. From the paragraph bridging pages 15 and 16 of D4, it emanated that entrained catalyst particles deposited in the outlet could lead to a temperature runaway. The "hot spot" problem associated with catalyst entrainment and deposition was addressed in the patent in suit. This problem could be avoided by foreseeing means for deliberately trapping entrained catalyst particles. The claimed solution was not obvious in view of the documents cited by the appellant. D5 concerned a different field of technology, namely gas-solid fluidised beds. The skilled person would thus not even take D5 into consideration or try to combine its teaching with the one of D4. Moreover, D5 did not describe cooling of the freeboard zone, let alone the generation of a liquid reflux by condensation, and the skilled person would not expect the type of particle separator described in D5 to work without clogging in a

wet environment. D1 mentioned entrainment of catalyst particles but foresaw trapping means outside and downstream of the reactor. A2 merely disclosed a washer on top of a polymerisation reactor to protect a reflux cooler.

## Reasons for the Decision

### *Main request*

#### 1. *Allowability of the amendments*

1.1 The present independent claim 1 is based on claims 1, 3, 4, 5, 6 of the PCT application. Claim 1 also contains features which were not claimed in the PCT application. In particular, the "*cooling means in the freeboard zone*" referred to in claim 4 of the PCT application are now further qualified as being "*indirect*" cooling means, and it is additionally required that the slurry zone is also "*cooled by indirect cooling means*". Moreover, the Fischer-Tropsch ("FT" hereinafter) reaction is required to be carried out "*using a cobalt catalyst*" and "*using a superficial gas velocity of syngas in the range of from 5 to 50 cm/sec*".

1.2 Indirect cooling of the slurry zone is expressly preferred according to page 4, lines 26 to 27 of the PCT application. The possibility of using indirect cooling means such as cooling coils in the freeboard zone is expressly mentioned on page 3, lines 26 to 30. Moreover, the only (and hence preferred) embodiment of a reactor specifically adapted to carry out the process of the invention actually described in the PCT

application, comprises indirect cooling means in the freeboard zone (see tubes 20 in figures 2 and 3) in combination with cooling means in the slurry zone (see page 14, lines 24 to 26]. Indirect cooling means in the freeboard zone are thus not generally considered to be disadvantageous in the application as filed, as alleged by the appellant. What can be understood from the passages of the PCT application relating to indirect cooling means in the freeboard zone is not that such means should generally be avoided, but that the volume occupied by them should be minimised, see page 3, line 25 to page 4, line 6 and page 4, lines 28 to 32. Although the apparatus shown in the figures has cooling tubes which do not extend into the freeboard zone (see page 14, lines 24 to 26), this measure is presented as a merely preferred option in the general part of the description (see page 4, lines 28 to 32).

- 1.3 Cobalt is presented in the PCT application as the most preferred catalyst for carrying out the preferred particular exothermic reaction to which claim 1 is restricted, i.e. the Fischer-Tropsch reaction (see page 7, lines 27 to 30). The presently claimed range of "*from 5 to 50 cm/sec*" stems from a combination of the upper limit of the preferred range for the superficial velocity of the synthesis gas used in the reaction of "*from 0.5 to 50 cm/sec*" with the lower limit of the more preferred range of "*from 5 to 35 cm/sec*", see page 9, lines 27 to 29 of the PCT application. Such an amendment is allowable according to established case law, see e.g. decision T 0925/98, point 2. of the Reasons.

1.4 Contrary to the factual situation underlying decision T 0686/99, see points 4.3 to 6.2 of the Reasons), where the application as filed contained no pointers to the particular combination of features comprised in the amended claim and selected within two lists of alternative features, the amendments to present claim 1 merely comprise the introduction of features which were recited in the claims of the PCT application and/or which were presented as preferred process and apparatus features in the description and/or the drawings thereof. Hence, the board concludes that the claimed subject-matter was not artificially created but clearly and unambiguously derivable from the PCT application. Since the skilled person is not presented with information which is not clearly and unambiguously derivable from the PCT application, the amendments in question do not provide the respondent with an "unwarranted advantage" in the sense of G 0001/93 (OJ EPO, 1994, 541), point 9. of the Reasons.

1.5 Claim 2 corresponds to claim 7 of the PCT application and claim 3 is based on a combination of claims 8, 9 and 10 thereof.

1.6 By virtue of the amendments, the subject-matter covered by claims 1 and 3 has been restricted with respect to that of claims 1 and 8 as granted. The board is thus satisfied that the amendments to the claims meet the requirements of Article 123(2) and (3) EPC.

2. *Support of the claims by the description*

2.1 The appellant was of the opinion that claim 1 was not supported by the corresponding description in view of

its wording as compared to the amended wording of sections [0020] and [0049] of the description. In particular it considered that according to the amended description section [0020], it was a requirement that the indirect cooling means in the slurry zone did not extend into the freeboard zone, and that according to the amended description section [0049], the means to trap particles necessarily comprised corrugated plates, whereas these features were not mandatory according to claim 1.

- 2.2 The board however notes that the amended description refers to the amended claim 1 by way of the general reference in section [0007].
- 2.3 Moreover, neither amended section [0015] nor sections [0016], [0018] or [0019], which all relate to the indirect cooling means in the freeboard and slurry zone, refer to the requirement addressed in section [0020] and in the present dependent claim 2. In the last sentence of section [0016], it is indicated the minimisation of the internals' volume, which is also addressed in section [0020] is merely a "preferred" mode. Amended section [0020] can thus still be understood, despite the deletion of the word "preferably", to refer to a more specific embodiment with a minimised volume of the internals in the freeboard zone.
- 2.4 Furthermore, sections [0047] and [0048] describe "*means to trap catalyst particles*" in a more general way than the subsequent section [0049]. In particular, it can also be gathered from the sentence "*Preferably, the gases are forced to follow a tortuous path.*" in section

[0049] that a "*means to trap catalyst particles*" as referred to in claim 1 will not necessarily have to comprise an arrangement comprising multiple corrugated plates defining such a tortuous path (see the last sentence of [0049]).

2.5 From the above, the board concludes that amended claim 1 is supported by the amended description within the meaning of Article 84 EPC.

### 3. *Sufficiency*

3.1 From the type of questions raised by the appellant when objecting to the sufficiency of the disclosure, it is apparent that the appellant merely considers that due to the alleged discrepancies between the amended description and claim 1, the reader of the patent would not know what the bounds of the invention are. However, the appellant has not presented any argument in support of its allegation that the skilled person would not know how the invention was to be performed. In particular it did not indicate why the skilled person would not be able to carry out the process according to present claim 1, which it considered to be broader than and thus unsupported by the amended description, or the more restricted process alternative of claim 1 (i.e. with corrugated plates). Neither does the board see why a skilled person should not be able to carry out such processes on the basis of the information given in the description. Since the claims are clear and supported by the description (see point 2. above), the skilled person would also know when it is "working within the forbidden area of the claims" (language used in

decision T 0256/87 cited by the appellant (see point 17. of the Reasons).

3.2 The patent as amended is thus not objectionable under Article 100(b) EPC.

4. *Novelty*

The process and the reactor as claimed in claims 1 and 3 are novel over the disclosure of the cited documents. As this was not disputed, further considerations in this respect are not necessary.

5. *Inventive step*

5.1 Closest prior art

5.1.1 Considering that D4 bears a stamp showing receipt by "OSTI" (according to the appellant an acronym for "US Department of Energy Office of Scientific and Technical Information") on 4 March 1996 and a stamp indicating that "Distribution of this document is unlimited", the board accepts that it was made available to the public before the priority date of the opposed patent. This was not disputed. In view of the similarities between the process and the reactor disclosed in document D4 with the ones claimed, the board can accept that D4 represents the closest prior art. D4 undisputedly discloses a process for carrying out three-phase Fischer-Tropsch reactions in a slurry bubble column reactor. The reactor used comprises a slurry zone having cooling tubes, i.e. indirect cooling means, arranged therein, and a freeboard zone called "vapour disengagement space"; see e.g. page 4, "Introduction",

page 6, third paragraph, figures 1, 3 and 4, reference number 27.10). According to the reactor temperature profile shown Figure 36, the temperature prevailing in the freeboard zone is roughly 35°F lower than the one prevailing in the slurry zone. In the absence of any specific cooling devices, this lower temperature results from indirect cooling of the freeboard zone by means of heat leakage through the reactor wall. In its letter L1 Professor Deckwer, author of P1A and thus expert in the field of bubble column reactors, expresses his opinion that the gaseous products obtained and the temperatures involved according to D4 will guarantee a considerable reflux of condensed products along the reactor wall in the freeboard zone, and that this reflux will transport splashed and entrained catalyst particles down to the slurry phase. The board can accept this expert opinion since it is plausible and was not countered by the respondent.

- 5.1.2 However, the board cannot accept the appellant's view that heat leakage through the reactor wall falls under the expression "*indirect cooling means **in** the freeboard zone*" (emphasis added by the board) as used in claim 1. Although the reactor walls cooled by the ambient air define the freeboard zone, they are not means arranged "*in*" this zone. This understanding of claim 1 is also in accordance with the description of the patent as granted where the expression "*cooling means in the freeboard zone*" (see section [0015]) is used to designate an alternative to the external cooling of the wall surrounding the freeboard zone (see section [0013]) and to cooling by heat leakage through the reactor wall (see section [0014]), said alternative being moreover



expressly designated as "*internals*" (see section [0016], first sentence).

5.1.3 Moreover, D4 does not disclose the features of claim 1 according to which "*the freeboard zone contains means to trap catalyst particles*". The board notes that this expression was already present in claim 6 as granted. Since the parties did not agree on its meaning, it has to be interpreted in the light of the description as far as necessary for comparing claim 1 and the prior art. It is accepted that catalyst particles present in the freeboard zone of D4 may also be deposited on the walls defining the boundaries of this zone and in the outlet of the reactor (page 16, line 3 of D4). However, in the light of the information in the description of the patent in suit, this does not permit considering that the freeboard zone of D4 "*contains*" the said walls and outlet, which would then have to be considered as "*means to trap catalyst particles*" in the sense of the present claim 1. The use of the term "*however*" in section [0046] of the description indicates that the means to trap catalyst particles belong to the "*internals*" that may be present in the freeboard zone as discussed in the preceding section [0045]. From section [0004], line 28, it can be understood that the "*reactor wall*" does not belong to the "*internals*". Moreover, it emanates from the description that the means to trap catalyst particles are additional means provided for achieving something that does not occur in a conventional reactor, and hence that the walls and outlet are not considered as catalyst traps contained in the freeboard zone. Therefore, D4 neither discloses the use of "*indirect cooling means in the freeboard*

zone" nor that "*the freeboard zone contains means to trap catalyst particles*".

## 5.2 Technical problem

5.2.1 As indicated in the patent in suit in sections [0004] and [0005], entrainment and deposition of catalyst particles in the freeboard zone can lead to unwanted "hot spots". Also according to D4 catalyst particle deposition may occur in the outlet and lead to temperature runaway.

5.2.2 Starting from D4, the technical problem can be seen in providing a further process and reactor for carrying out exothermic reactions, such as FT reactions, in a three-phase slurry reactor, wherein catalyst particles are efficiently removed from the freeboard zone (see also section [0005] of the description). It is plausible that the arrangement of a particle trap in the freeboard zone together with the maintaining of a liquid reflux in this zone to remove catalyst particles therefrom will lead to a decreased deposition of particles on other parts of the reactor in the freeboard zone, e.g. the outlet, where they may lead to problems such as hot spot formation.

## 5.3 Non-obviousness

5.3.1 The claimed process is not obvious in view of D4 taken alone, since this document does not mention or suggest arranging indirect cooling means or means to trap catalyst particles in the freeboard zone of the reactor.

5.3.2 D5 relates to processes and apparatuses for effecting fluidised contact between solid particles and "fluid mediums". Although according to D5 solid particles are contacted with "fluid mediums", there is nothing in D5 suggesting that other processes than gas-solid fluidised bed processes are meant (see column 1, lines 1 to 14). D5 mentions "liquid reactants", but only in connection with the description of earlier prior art methods (column 2, lines 22 to 27), starting products which are "normally liquid", i.e. only under normal conditions which are not the high temperature process conditions mentioned (column 6, lines 44 to 53), and high-boiling hydrocarbons which are "adsorbed" on the catalyst particles (column 7, lines 43 to 55), i.e. which do not form a continuous liquid phase. Otherwise, the only fluid media referred to in D5 are vapours or gases, including in the case of FT synthesis described in column 7, lines 8 to 55. The board concludes that D5 is not concerned with reactors wherein a slurry of catalyst particles suspended in a liquid medium is contacted with gas, i.e. with three-phase slurry reactors.

5.3.3 The reactor described in D5 comprises a centrifugal type separator 10 for separating entrained catalyst particles from the outgoing product stream 11 and returning them to the fluidised bed, see Figure 1 and column 4, lines 25 to 33. Only the lower part of the centrifugal separator shown in Figure 1 is arranged within the freeboard zone, whereas its upper part is arranged outside of the reactor. Although it can be accepted that the gases passing through this upper part might be indirectly cooled to some extent by the ambient air surrounding it, this does not imply that

any condensation of products will take place. A liquid reflux in this part of the reactor is not envisaged according to D5.

5.3.4 It is thus questionable whether the skilled person starting from D4 and confronted with the stated technical problem would consider D5 at all in view of the different process type to which the latter refers. Even accepting, purely for the sake of argument, that the skilled person would consider D5, he would not envisage arranging the cyclone type separator described in D5 in connection with a dry solid-gas separation for separating particles potentially sticking to reactor walls in the wet environment prevailing in the freeboard zone of the reactor of D4. Moreover, arranging such a device within the freeboard zone of the reactor of D4 would not lead to the cooling of the freeboard zone by internal indirect cooling means arranged therein as required by present claim 1. The board concludes that the skilled person would not, in the absence of hindsight considerations, be induced by D5 to modify the reactor described in D4 in a manner leading to a reactor with all the features of present claim 1. This finding also applies to the second alternative recited in claim 1 which is even more specific as far as the means to trap particles are concerned.

5.3.5 Documents A1, A2 and D1, upon which the appellant only relied in case the reactor walls of D4 would not be regarded as constituting indirect cooling means and a catalyst trap in the sense of present claim 1, do not point towards the claimed process either. Document A1 discloses the introduction of slurry liquid ("contact

oil") into the freeboard zone by means adapted to wash the reactor walls free of catalyst particles, but it does not disclose or suggest indirect cooling means in the freeboard zone or means to trap catalyst particles, see figures 1 and 5 and column 3, lines 28 to 37, column 4, lines 38 to 45 and column 5, lines 67 to 70. Document D1 merely mentions the arrangement of a "reflux coil" in the "reactor head" of a three-phase slurry reactor used for carrying out FT reactions, see Figure 2, reference "e" and Figure 3. Material is entrained out of the reactor and is trapped in a device ("entrainment trap") arranged outside and downstream of the reactor (see Figure 2, reference "n" and Figure 3). Document A2 is merely concerned with reactors for the polymerisation of olefins in a solvent. Heat is removed by means of a reflux condenser with heat exchange surfaces which condenser can optionally be "directly mounted on" the reactor (Fig 1F), but which is not arranged within the gas space in the reactor. The reflux condenser is protected from deposition of entrained catalyst and polymer particles by arranging a "washing apparatus" between the reactor and the condenser, see column 1, lines 6 to 10, "Summary of the invention", column 2, lines 54 to 62, column 3, lines 14 to 17, column 4, lines 7 to 21 and Figure 1F.

- 5.3.6 The reactor according to independent claim 3 is adapted to maintain a liquid reflux in the freeboard zone and contains specific means to trap particles, comprising a plurality of corrugated plates arranged substantially vertically. None of the documents cited by the appellant discloses particle trapping means comprising these specific features. The appellant merely alleged that the skilled person would combine the teachings of

D4 and D5 and additionally modify the trapping means disclosed in the latter. However, for the reasons given above, the skilled person would not consider combining D4 and D5. Moreover, the appellant's allegation that the further modification that would be required to arrive at the reactor of present claim 3, i.e. the replacement of the centrifugal separator by vertical corrugated plates, was an obvious engineering alternative cannot be accepted since it was not corroborated by any technical arguments or evidence.

5.3.7 The subject-matter of independent claims 1 and 3, and, consequently, of dependent claim 2 is thus based on an inventive step.

## **Order**

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

The appeal is dismissed.

The registrar

The chairman

C. Vodz

M. Eberhard