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Datasheet for the decision of 6 December 2016

Case Number: T 1030/13 - 3.3.10

Application Number: 01919301.0

Publication Number: 1257517

IPC: C07C15/085, C07C2/86, C07C39/04, C07C31/10, C07C29/145

Language of the proceedings: EN

Title of invention:
PROCESS FOR PREPARING CUMENE WHICH IS USED IN THE PREPARATION OF PHENOL

Patent Proprietor:
INEOS Phenol GmbH & Co. KG

Opponent:
versalis S.p.A.

Headword:
PROCESS FOR PREPARING CUMENE/ INEOS PHENOL

Relevant legal provisions:
EPC Art. 56, 114(2)

Keyword:
Inventive step - obvious alternative

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Decisions cited:

Catchword:

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Case Number: T 1030/13 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 6 December 2016

Appellant: (Opponent)	versalis S.p.A. Piazza Boldrini 1 20097 San Donato Milanese (IT)
Representative:	Coletti, Raimondo Barzanò & Zanardo Milano S.p.A. Via Borgonuovo, 10 20121 Milano (IT)
Respondent: (Patent Proprietor)	INEOS Phenol GmbH & Co. KG Dechenstrasse 3 45966 Gladbeck (DE)
Representative:	f & e patent Fleischer, Engels & Partner mbB, Patentanwälte Braunsberger Feld 29 51429 Bergisch Gladbach (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 27 February 2013 concerning maintenance of the European Patent No. 1257517 in amended form.**

Composition of the Board:

Chairman	P. Gryczka
Members:	J.-C. Schmid
	T. Bokor

Summary of Facts and Submissions

I. The Appellant (opponent) lodged an appeal against the interlocutory decision of the Opposition Division which found that the European patent No. 1 257 517 amended according to the then pending third auxiliary request met the requirements of the EPC. Claim 1 of that request read as follows:

"1. A process for the preparation of cumene by reacting isopropanol with benzene in a liquid phase in presence of a B-zeolite catalyst having a SiO_2/Al_2O_3 molar ratio greater than 10: 1, wherein the acidity of the catalyst is modified by surface addition of water and propene formed by dehydration of isopropanol simultaneously with the alkylation of benzene to cumene by means of isopropanol is used for the alkylation of benzene to cumene, whereby a trickle-bed reactor is used at a linear velocity of the liquid phases in the reactor of greater than 30 m/h."

II. Notice of opposition had been filed by the Appellant requesting revocation of the patent-in-suit in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC) and extension of the subject-matter of the patent-in-suit beyond the content of the application as filed (Article 100(c) EPC).

Inter alia, the following documents were cited in the opposition proceedings

(1) EP-A-1 069 100
(2) EP-A-0 538 518

(5) K.S.N. Reddy et al, "Alkylation of benzene with isopropanol over zeolite beta", Applied Catalyst, 95, pages 53 to 63, 1983 and
(26) EP-A-0 776 876.

According to the Opposition Division, the subject-matter of claim 1 of the patent as granted did not extend beyond the content of the application as filed (Article 100(c) EPC). However, the subject-matter of granted claims 1 and 13 and that of claims 1 and 13 of the then pending first and second auxiliary requests was not novel over document (1). The Opposition Division admitted the then pending third auxiliary request into the proceedings, since it had been filed in due time and aimed to overcome novelty objection. The added feature that "a trickle-bed reactor is used at a linear velocity of the liquid phases in the reactor of greater than 30 m/h" was supported by page 9, line 1 to 3 in combination with the passage of page 8, line 34 to page 9, line 2 of the application as filed. The subject-matter of claims 1 and 13 of the then pending third auxiliary request was clear and satisfied the requirements of Article 123(2) and (3) EPC. The added feature was not disclosed in the cited documents. The subject-matter of claims 1 and 13 of the third auxiliary request was therefore novel. Document (5) represented the closest prior art. This document lacked the feature that the reaction was done in the liquid phase, since the optimum conditions for the selective formation of cumene at atmospheric pressure were taught to be 210°C. Furthermore, a trickle bed was not used in document (5) to bring water in intimate contact with the catalyst and there was no mention of a modification of the acidity of the catalyst. Document (26) disclosed the alkylation of benzene with olefins in a gaseous phase. Therefore, the subject-matter of

claims 1 and 13 was not rendered obvious by the combination of document (5) with document (26). The opposition division concluded that the subject-matter of claim 1 and 13 of the then pending third auxiliary request met the requirement of inventive step.

III. According to the Appellant, the Opposition Division should not have admitted the then pending third auxiliary request into the proceedings, because the EPO did not carry out an additional search on the amended subject-matter. Furthermore, the amendments carried out in claim 1 did not fulfil the requirements of Articles 123(2) and 84 EPC. Document (2) was the closest prior art to the invention. This document disclosed a process for the preparation of cumene which comprised reacting benzene with a propene or propyl alcohol in the presence of a ß zeolite catalyst in a reactor at a temperature in the range of 150 to 250°C and a pressure in the range of 1 to 35 atmospheres. The process of claim 1 of the patent-in-suit differed from the process disclosed in document (2) only by the indication of the linear velocity of the liquid phases in the reactor of greater than 30 m/h. The claimed process was not sufficiently disclosed, since there was no indication in the patent-in-suit as to how to modify the catalyst acidity by surface addition of water, how to assess the acidity and how to achieve a continuous phase with propene to form a continuous gas phase for operating the process in the trickle-bed mode reaction. Since propene reacted with benzene to form cumene, there would not be enough propene left to form a continuous gas phase. The proposed solution to the problem of providing an alternative process consisting in operating the process in liquid phase was obvious in the light of document (2), since among the temperatures and pressures taught to be suitable in this document,

there were clearly couples of values of temperature and pressure for which the reaction mixture was in a liquid phase, as experimentally demonstrated. The features that the acidity of the catalyst was modified by surface addition of water and that propene formed by dehydration of isopropanol reacts with benzene to form cumene were the inevitable consequence of carrying the process in liquid phase. Document (26) described a process of alkylation of aromatic hydrocarbons comprising the step of reacting said aromatics with olefins in liquid phase in a trickle flow region at a temperature of from 100 to 300°C under a pressure of from 10 to 50 atm. The claimed feature that the trickle bed reactor had to be operated at linear velocities of the liquid phases in the reactor of greater than 30m/h was usual in order to ensure intimate contact between the liquid phase and the catalyst bed. The subject-matter of claim 1 lacked therefore an inventive step in the light of the teaching of document (2) and document (26).

IV. According to the Respondent, it was common practice to amend claims by incorporation of features disclosed in the application as filed. Furthermore, the Appellant had never argued that the Opposition Division exercised its discretion in an inappropriate way in admitting the then pending auxiliary request 3 into the proceedings. Therefore, the Appellant's arguments that this request should not be admitted into the proceedings should be rejected. The claims of the then pending auxiliary request 3 also fulfilled the requirements of Articles 84, 123(2) and (3) EPC.

Document (2) might be considered to represent the closest prior art. This document disclosed temperature and pressure ranges, whereby only specific combinations

of temperature and pressure might result in a liquid phase. Such combinations were however not disclosed in document (2). Only example 14 of document (2) disclosed the reaction of isopropanol with benzene. It was run at atmospheric pressure and 205°C. Under these conditions, isopropanol was completely in the gaseous phase and thus the reaction was not run in a trickle-bed reactor requiring the presence of a liquid phase. Accordingly, document (2) only disclosed the alkylation of benzene with isopropanol in gas phase. Hence, it could not be concluded that an inherent modification of the acidity of the catalyst by surface addition of water took place and there were also no proof that propene was formed in the gas phase. The technical problem to be solved was the provision of an alternative process for preparing cumene. The solution was the process of claim 1 characterized by carrying out the reaction in a liquid phase, by modifying the acidity of the catalyst by surface addition of water, by using propene, which is formed by dehydration of isopropanol simultaneously in the alkylation of benzene with isopropanol to cumene, for the alkylation of benzene to cumene and, by using a trickle-bed reactor at a linear velocity of the liquid phases in the reactor of greater than 30 m/h. The modification of the acidity of the catalyst by surface addition of water was inherent to the process when carried out in the liquid phase, as was the formation of propene. This was even shown by the Appellant's reproduction of example 6 of document (1) where benzene was reacted with isopropanol in a liquid phase producing significant propene. The claimed process was therefore a solution of the problem of providing an alternative process for preparing cumene.

The skilled person had no incentive to specifically select a temperature/pressure pair from the range

disclosed in document (2) in order to carry out the reaction in liquid phase. The skilled person would not combine the teaching of document (2) disclosing a gas phase reaction of isopropanol with benzene with document (26) which relates to a totally different type of reaction, since a gas phase reaction cannot be run in a trickle bed reactor due to the lack of liquid phase. Furthermore, even if the person skilled in the art was inclined to turn to document (26) when looking for an alternative process for preparing cumene, he would arrive at the solution of using propene as the reactant, and not at the claimed solution which involves isopropanol. Consequently, the subject-matter of the claims of the main request involved an inventive step.

V. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested that the appeal be dismissed.

VI. At the end of the oral proceedings held on 6 December 2016, the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

2. The sole claim request in these appeal proceedings is the third auxiliary request which was filed on 5 December 2012 during the oral proceedings before the Opposition Division and which was held allowable in the impugned decision. The Appellant requested the Board not to admit it into the appeal proceedings.

The opposition division had decided to admit this request into the opposition proceedings (cf. impugned decision, point 18.1 of the Reasons) after having heard the parties on this issue during the oral proceedings (cf. minutes, point 12). In view of that, it appears that the opposition division exercised its discretion under Article 114(2) EPC taking into account the right principles and in a reasonable way. Furthermore, there is no legal basis in the EPC which requires the EPO to carry out an additional search on claims amended in the opposition proceedings. Thus, the admissibility of this request in the opposition proceedings, and consequently in the appeal proceedings which are entirely based on this request, is not to be objected to.

3. Inventive step

3.1 *Closest prior art*

The Board accepts, in agreement with the parties, that document (2) may be considered to the closest prior art to the invention, and, hence takes it as the starting point in the assessment of inventive step.

Document (2) discloses a process for the preparation of cumene which comprises reacting benzene with propene or propyl alcohol in the presence of a ß zeolite catalyst in a reactor at a temperature in the range of 150 to 250°C and a pressure in the range of 1 to 35 atmospheres (see claims 1 and 2). The ß zeolite catalyst used in the process may have a silica to alumina mole ratio above 20 (claim 4). The catalyst used in the exemplified processes had a ratio of 47 and is loaded in a fixed bed, down flow, high pressure, high temperature catalytic reactor (see page 4, lines

55 to 57). More particularly, in the process described in table 14 on page 18, cumene was prepared by reacting benzene with isopropanol under atmospheric pressure at a temperature of 205°C.

3.2 *Technical* problem underlying the invention

According to the Respondent, the technical problem to be solved was the provision of an alternative process for preparing cumene.

3.3 *Proposed solution*

According to the Respondent, the proposed solution was the process of claim 1 characterized by

(a) carrying out the reaction in a liquid phase,

(b) modifying the acidity of the catalyst by surface addition of water

(c) using for the alkylation of benzene to cumene propene which is formed by dehydration of isopropanol simultaneously when alkylating benzene to cumene with isopropanol and,

(d) using of a trickle-bed reactor

(e) at a linear velocity of the liquid phases in the reactor of greater than 30 m/h.

The Appellant argued that document (2) disclosed features (a) to (d). However, since the Board comes to the conclusion that the process of claim 1 is not inventive even if the position of the Respondent is followed, it is assumed that document (2) does not

explicitly disclose any one of the features (a) to (e).

3.4 Success

According to the Appellant, there was no teaching in the application as filed as to how to modify the catalyst acidity by surface addition of water, nor means to ascertain whether acidity changes has been achieved. The skilled person could therefore not execute feature (b).

However, as the Respondent explained, water is inevitably formed during the alkylation of benzene with isopropanol in a liquid phase. Therefore, feature (b) is achieved as being the inevitable consequence of carrying out the process in a liquid phase. Accordingly, the alleged absence of means to measure the acidity modification is also not relevant for the claimed process to be carried out.

According to the parties, feature (d) "using a trickle-bed reactor" actually relates to operating conditions carried out in the reactor, i.e. requires the presence of three phases in the reactor, namely solid, liquid and gas. A fixed bed reactor in which a liquid phase and a gas phase flow concurrently through a fixed bed of catalyst particles while reaction takes place is a trickle-bed reactor. Feature (d) therefore requires in addition to the solid catalyst, the presence of both liquid and gas phase in the reactor.

The Appellant objected that there would not be enough propene released *in situ* to form a continuous gas phase for operating the process in the trickle-bed mode

reaction, if propene reacts in the liquid phase with benzene to form cumene.

However, a process for preparing cumene by reacting isopropanol with benzene is described on page 39 of the letter of the Appelant's statement of the grounds of appeal dated 27 June 2013. The process is carried out at 190°C under a pressure of 30 bar, i.e. in liquid phase. Under these conditions, the reaction produces, in addition to cumene, 20% of propene gas. Therefore, it may realistically be assumed that part of the formed propene is dissolved in the liquid phase to further react with benzene to form cumene (feature (c)), whereas sufficient propene remains in the reactor to form a gaseous phase allowing the reactor being operated as a trickle bed reactor. Furthermore, it has not been contested that a trickle bed reactor can be operated with a linear velocity of the liquid phases in the reactor of greater than 30 m/h.

Therefore, the Board holds that it is credible that the process of claim 1 is a solution to the technical problem of providing an alternative process for the preparation of cumene.

3.5 Obviousness

Document (2) discloses a process for the preparation of cumene comprising reacting benzene with propyl alcohol in the presence of a ß zeolite catalyst (see table 14). This process is carried out at atmospheric pressure at 205°C. Under these conditions of temperature and pressure, the process is carried out in gas phase.

Document (2) furthermore teaches that the process can be carried out at a temperature in the range of 150 to

250°C and a pressure in the range of 1 to 35 atmospheres (see claim 1). Therefore, the skilled person seeking an alternative process to that disclosed in table 14 which is carried out at 205°C under atmospheric pressure would contemplate temperatures in the range of 150 to 250°C and pressures in the range of 1 to 35 atmospheres for carrying out the alkylation of benzene with propyl alcohol.

The alkylation of benzene with isopropanol can be carried out in a liquid phase by choosing appropriate temperature and pressure pairs which are comprised in the ranges disclosed in document (2). At a temperature of 190°C and under a pressure of 30 atmospheres, the reaction the alkylation of benzene with propyl alcohol occurs in a liquid phase (see the experimental data provided by the Appellant with the statement of the grounds of appeal dated 27 June 2013).

Accordingly, feature (a) is fulfilled by temperature and pressure pairs which are within the ambit of document (2). Features (b) to (d), which also characterise the proposed solution, are the inevitable consequences of carrying out the reaction in a liquid phase (see point 3.4 above).

In particular, water formed during the alkylation of benzene with isopropanol in a liquid phase modifies the acidity of the catalyst (feature (b)) and part of propene formed by dehydration of isopropanol simultaneously with the alkylation of benzene remains in the liquid phase to react with benzene to form cumene (feature (c)), while the remaining propene forms a gaseous phase allowing operating the reactor in a trickle bed reaction mode (feature (d)).

With respect to feature (e), the Respondent did not provide any evidence which shows that velocities above the claimed threshold of more than 30 m/h are those that the skilled person would not have contemplated when carrying out the process of alkylation of benzene with isopropanol in a liquid phase. Setting arbitrarily a threshold of linear velocities of the liquid phases in a reactor does not impart an inventive step to the claimed subject-matter.

Hence, the subject-matter of claim 1 of the patent in suit results from an arbitrary choice of a particular temperature/pressure pair within the ambit of document (2) and an arbitrary threshold of linear velocities of the liquid phases in a reactor and, hence, lacks an inventive step in view of document (2) alone.

The Respondent argued that the skilled person could have chosen a temperature/pressure pair from the range disclosed in document (2) wherein the reaction occurs in a liquid phase, but would not have done so, because he had no incentive to do that.

However, this argument is not convincing since no specific motivation is required to make an arbitrary choice of a particular embodiment from a host of equally possible embodiments in order to provide a mere alternative. Since the subject-matter of claim 1 lacks an inventive step in the light of document (2), it is unnecessary to decide whether the skilled man would have turned to document (26) or whether he would have arrived at the claimed subject-matter by combining document (2) with document (26).

The Board comes to the conclusion that, in the light of the evidence on file, claim 1 of the sole request does not fulfil the requirement of Article 56 EPC.

4. Other issues

The Appellant also submitted that claim 1 did not fulfil the requirements of Articles 123(2) and 84 EPC and that document (1) was a document pursuant Article 54 (2) EPC.

In view of the negative conclusion in respect of inventive step for the subject-matter of claim 1 in the light of document (2) as set out above, a decision of the Board on these issues is unnecessary.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

K. Boelicke P. Gryczka

Decision electronically authenticated