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Case Number: T 1757/08 - 3.3.06

Application Number: 99930243.3

Publication Number: 1109607

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Language of the proceedings: EN

Title of invention:
Cascade reboiling of ethylbenzene/styrene columns

Patentee:
Stone & Webster, Inc.

Opponent:
THE DOW CHEMICAL COMPANY

Headword:
Cascade reboiling/STONE

Relevant legal provisions:
EPC Art. 123(2)

Relevant legal provisions (EPC 1973):
-

Keyword:
"Added subject-matter (all requests): yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 1757/08 - 3.3.06

D E C I S I O N
of the Technical Board of Appeal 3.3.06
of 3 December 2010

Appellant: (Patent Proprietor)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 11 July 2008 revoking European patent No. 1109607 pursuant to Article 101(2) EPC.

Composition of the Board:

Chairman: L. Li Voti
Members: P. Ammendola
U. Tronser

Summary of Facts and Submissions

I. This appeal is from the decision of the Opposition Division to revoke European patent No. 1 109 607 concerning cascade reboiling of ethylbenzene/styrene columns.

The **granted** claim 7 read:

"*7. A process for separating styrene monomer from a mixed hydrocarbon stream consisting essentially of styrene and ethylbenzene comprising the steps of:*

(a) splitting said mixed hydrocarbon stream into first and second portions

(b) distilling said first portion in a first distillation column packed with a packing material and operated under process conditions wherein the lower region of the first column is at a pressure of 0.34-0.62 bar a(5-9 psia) and a temperature of about 110-130°C and the upper region of this column is at a pressure of 0.28-0.49 bar a (4-7 psia) and a temperature of 90-110°C so as to produce partially purified styrene as a first-column bottoms stream and to produce a first-column overhead stream consisting essentially of ethylbenzene;

(c) distilling said second portion in a second distillation column packed with a packing material and operated under process conditions wherein the lower region of said second column is at a pressure of 0.07-0.21 bar a (1-3 psia) and a temperature of 70-95°C and the upper region of this column is at a pressure of 0.027-0.10 bar a(0.4-1.5 psia) and a

temperature of about 40-70°C so as to produce partially purified styrene as a second-column bottoms stream and to produce a second-column overhead stream consisting essentially of ethylbenzene; and

(d) heating a recycle portion of said second-column bottoms stream by bringing it into thermal contact with said first-column overhead stream so as to cool and at least partially condense said first-column overhead stream, and thereafter returning the heated second-column bottoms stream to a lower region of said second column."

II. The granted patent had been opposed, *inter alia,* on the grounds of extension beyond the content of the application as filed (Article 100(c) EPC 1973) and of lack of inventive step (Article 100(a) EPC 1973).

The following documents were referred to, *inter alia*, during the opposition proceedings:

(2) WO-A-98 131 17;

and

(9) "*Packed Towers reduce cost",* Strigle & Percy, Hydrocarbon Processing, February 1981, pages 103 to 107.

III. In its decision the Opposition Division considered, *inter alia*, that the requirement that the distillation columns had to be "*packed with a packing material*" (hereinafter the **packing feature**) also added in the

process claim 7 of the granted patent, corresponded to the implicit disclosure of the patent application as originally filed (and internationally published).

In particular, the Opposition Division noted that the original description discussed at length the recycling and separation of the mixture of compounds resulting from the industrial dehydrogenation of ethylbenzene (hereinafter EB) into styrene monomer (hereinafter SM). The description of the prior art given in the application as filed stressed that the large number of theoretical distillation stages required to effect the separation of the close-boiling EB and SM was achieved by using either structured or random dump packing materials, because packed columns would intrinsically have much lower pressure drop compared to standard tray columns and, thus, allowed for lower temperatures at the bottom of the distillation columns, thereby reducing undesired SM polymerization.

Alone in the light of these explanations given in the application documents as originally filed, it would be clear for the skilled person that the columns in cascade reboiling arrangement (hereinafter CR columns) to be utilised in the apparatus and the process of the invention were also packed with a packing material. Moreover, it would be apparent to the skilled reader of the patent application that the low-pressure and high-pressure columns of example 2, which was the example of the invention, were also packed columns. A complementary (albeit per se not sufficient) indication resulted from Figure 1 of the patent application, wherein, the installed equipment of the distillation columns was designated with a X symbol, which was very frequently

used to represent a bed of packing. Consequently, the packing feature of the process of claim 7 was derivable from the application documents as filed.

The Opposition Division was however of the opinion that the patented subject-matter lacked of an inventive step.

IV. The Patent proprietor (hereinafter Appellant) lodged an appeal against this decision.

During oral proceedings the Appellant requested that the decision under appeal be set aside or, in the alternative, that the patent be maintained on the basis of any of the sets of claims of the first to third auxiliary requests filed with letter of 5 November 2010, or of the fourth auxiliary request filed during oral proceedings.

The Opponent (hereinafter Respondent) requested that the appeal be dismissed.

V. For the present decision it is sufficient to consider, in addition to the **granted claim 7** already cited above at section I, in particular:

claim 5 of the first auxiliary request, which only differs from claim 7 as granted in that the word "*and*" before "*(d)…*" was deleted and the final wording of this latter

" *column.*"

has been replaced by

" *column, further comprising*

(e) a distillation step upstream from said splitting step to substantially remove lighter components of said mixed hydrocarbon stream, and

(f) a distillation step downstream from said first and second distillation columns to substantially separate heavier hydrocarbon components from said partially purified styrene.";

claim 1 of the second auxiliary request, which is identical to granted claim 7 renumbered;

claim 1 of the third auxiliary request, which is identical to claim 5 of the first auxiliary request renumbered,

and

claim 1 of the fourth auxiliary request, which only differs from claim 1 of the third auxiliary request in that the expressions in this latter reading

"*(e) a distillation step upstream*"

and

"*(f) a distillation step downstream*"

have respectively been replaced by

"*(e) a distillation step in a third distillation column packed with a packing material upstream*"

and

"(*f) a distillation step in a fourth distillation column packed with a packing material downstream*".

VI. The Appellant's arguments presented in writing and orally as to the disclosure of the packing feature in the original application may be summarized as follows.

The presence of a packing material in the CR columns used for separating EB/SM according to the patented invention would be evident when considering in combination the presence in the original patent application of the following technical teachings (hereinafter referred to as teachings "a)" to "d)"):

a) the original disclosure for each of these two CR columns of an overhead pressure range and a bottom pressure range whose "natural reading" would imply a pressure drop of not more than 2 psi along each column, i.e. a pressure drop only obtainable by packed columns and not by tray columns, as apparent from document (9);

b) the description of the starting point of the invention, as given in the original application by the mention of the advantages of packed columns of the prior art vis-à-vis tray columns and by the selection as prior art of comparison of the EB/SM distillation column of (comparative) Example 1, i.e.

a column explicitly identified as being packed with packing material;

c) the pressure drops over the length of each the two CR columns of (invention) Example 2 which were comparable to the pressure drop reported for the column of the (comparative) Example 1 and, thus, necessarily also indicative of the presence of packing material in the CR columns of Example 2;

and

d) the "X" symbols used in Figure 1, which were standard notations for the presence of packing materials in distillation columns.

Hence, the skilled person reading the application as a whole would be under no doubt that the process described in the application and the examples of the application clearly involved columns having a bed of packing material rather than trays.

The "X" symbols in the columns of the distillation train depicted in Figure 1 also disclosed the presence of packing materials in the two distillations columns of the distillation train preceding and following the CR columns. It was justified to extract the packing feature from the teaching in the Figure since this latter disclosed a framework for the embodiments of the invention and not a single specific set of features in combination. Moreover, the other characteristics of the invention (in addition to those expressed by the "X" symbols) possibly derivable from this Figure were not related to the packing feature. This applied, for

instance, to the fact that in this figure the process streams were always fed in the middle region of the distillation columns and/or to the setting of the reboilers. Hence, it was justified to just derive from Figure 1 a generally applicable instruction as to the preferable presence of packing materials in each of the columns of the distillation train according to the invention.

VII. The Respondent disputed this reasoning by arguing in writing and orally that the Opposition Division would have erred in considering granted claim 7 not to contain matter extending beyond the content of the application as filed. In particular, the sole theoretically possible basis for the presence of packing material in the columns of the process and the apparatus disclosed in the original patent application would be the ambiguous meaning of the "X" symbol on each of the four distillation columns of Figure 1. However, it would in no case be justified to selectively extract from this figure only some of the features depicted therein, leaving aside the other features given in the same Figure, such as the additional distillation columns, the feed of the product stream in the middle region of each column, the presence of a T-junction splitter or the use of reboilers in certain positions.

Moreover, even though packed columns were known to provide certain advantages, tray columns still represented a realistic option for the distillation of EB/SM at about the filing date of the patent-in-suit, as evident e.g. from document (2).

Hence, already the indication that the columns were packed resulted in the presence of added matter in claim 7 as granted, as well as in the corresponding process claims in the first to fourth auxiliary requests.

Reasons for the decision

Main request (patent as granted)

1. Added subject-matter in claim 7 as granted (Article 100(c) EPC 1973 and Article 123(2) EPC)

2. The Respondent has argued that the patent-in-suit contains subject-matter extending beyond the content of the patent application as originally filed, *inter alia*, because of the wording "*packed with a packing material*" as present, *inter alia*, in claim 7 as granted.

It is undisputed that the original application does not provide an explicit counter part for the packing feature.

The Appellant has nevertheless argued that the presence of a packing material in the CR columns for EB/SM separation, would be derivable when considering in combination the technical teachings "a)" to "d)" of the original patent application (see above section VI of the Facts and Submissions).

2.1 The Board finds, however, for the following reasons, that the teaching "a)" is not present in the original application and that the remainder teachings "b)" to "d)" are insufficient for rendering the packing feature

of granted claim 7 allowable under the provisions of Article 123(2) EPC.

2.1.1 As to the teaching "a)", the Appellant has argued that the skilled person's "natural reading" of the ranges given in the original application (and also present in steps "*(b)*" and "*(c)*" of the process of granted claim 7) for the overhead and bottom pressures in each of the two CR columns, would be that of linking maxima to maxima and minima to minima; this would imply that the maximum value (of 9 psi) for the pressure at the top of the first column in step "*(b)*" should only be read in combination with the corresponding maximum value (of 7 psi) for the pressure at the bottom, thus excluding a combination with other values of the bottom pressure range such as the minimum of 4 psi. Hence, the given pressure ranges would imply along each CR column a pressure drop of not more than 2 psi, i.e. a pressure drop only obtainable by packed columns and not by tray columns, as apparent from document (9).

The Board finds, however, that, in the absence of an explicit indication in the application, there exists no logical or technical reason that would justify to interpret the pressure ranges originally disclosed for the overhead and the bottom of each CR column to be necessarily interconnected in this way. Moreover, the Respondent has denied the existence of any such "natural reading" and the Appellant has provided no evidence that this is the conventionally accepted way for interpreting possibly correlated pressure ranges. Finally, the Board considers not clear how any such allegedly existing "natural reading" could be applicable by the skilled

person to any other (intermediate) values in the relevant pair of pressure ranges of the claim.

Hence, the alleged "natural reading" of the originally disclosed pressure ranges is found neither necessarily implied, nor conventional, nor clear and, thus, the teaching "a)" is found not given in the original application.

2.1.2 As to the teaching "b)", the Board concurs with the Appellant that the original application stresses the **advantages of packed columns in comparison to tray columns** in EB/SM distillation. Indeed, the description of the application explicitly mentions the reasons that had rendered current in the prior art the use of packed columns (see the passage in the application as filed at page 2, lines 25 to 29, reading "*Also, to achieve the larger number of stages required to effect the separation, currently either structured or random dump packing materials are used as the internal vapor/liquid contacting medium. Packing materials intrinsically have much lower pressure drop compared to standard distillation trays. With packing, the lower pressure drop allows the column to operate with a comparatively lower bottoms temperature.*"). The Board is also convinced that the particular suitability of packed columns for EB/SM distillation is further implicitly acknowledged by the use of a packed column for the (comparative) Example 1 representing the prior art.

However, this acknowledgment of the advantages of packed columns of the prior art does not appear *per se* to imply that the invention necessarily **consisted in a partial modification** of the EB/SM distillation process and

apparatus of the prior art based on packed columns. On the contrary, the fact that the inventor of the patent-in-suit has as well taken into consideration completely different prior art appears from the original description immediately following the above-cited acknowledgement of the advantages of packed columns, i.e. the description starting with the statement "*As a result of these various process difficulties, costs, and limitations, however, considerable incentive has existed for many years to develop alternative means of effecting this separation which could be more viable from either or both economic and ease of operation standpoints. A number of patents have attempted to address these problems in a variety of ways.*" (see from page 2, line 29 to page 3, lines 2) as well as from the subsequent mention of other prior art processes in which no use of packed columns appears relevant or likely (see e.g. on page 3 the use of "*wiped wall thin film evaporator*" mentioned at lines 4 to 7; or the use of a "*membrane*" mentioned at lines 15 to 19; or the use of "*two-phase solvent system*" at lines 21 to 27).

Moreover, the fact that the use of packed columns had become "*current*" at the filing date of the present application does not indicate (or necessarily imply) that the use of tray columns represented no longer a realistic option for the EB/SM distillation. For instance, as convincingly stressed by the Respondent, at least the authors of document (2) (see therein page 3, lines 15 to 31), published in April 1998, two months before the priority date of the patent-in-suit, appeared to still consider tray columns applicable to the distillation of EB/SM at about the time of filing of the patent-in-suit.

Hence, the skilled reader of the application as filed could at most deduce that the distillation process of Example 1 was still (in the opinion of the inventors) the most advantageous among the (then) "*current*" prior art. However, this fact does not equate to the direct and unambiguous disclosure that the process and system of the invention claimed in the original application resulted from the application of cascade reboiling to such most advantageous prior art. Accordingly, it is **not apparent** to the skilled reader of the application as filed that the inventor of the patent-in-suit had intended to **actually start from the packed distillation columns** of the prior art and, even less, that he had arrived at the claimed process **without changing the kind of distillation columns** used in as far as the advantageous presence of the packing material was concerned.

2.1.3 Hence, in the opinion of the Board, the only disclosure in the application as filed that is indicative of the presence of a packing material in the EB/SM columns of the claimed process and apparatus is provided by the pressure drop values reported for the invention Example 2 (teaching "c)") and by the "X" symbols in Figure 1 (teaching "d)").

It is self-evident, and undisputed by the Appellant, that the implicit presence of a packing material in the specific embodiment of the invention according to Example 2 does not represent a generally applicable teaching and, thus, is insufficient for supporting the packing feature over the whole range of claim 7.

The Appellant has however argued that the information conveyed by Figure 1 would instead amount to a generally applicable teaching as to the presence of packed columns in the distillation train of the invention.

The Board notes that the description of this Figure starts at line 8 of page 5 of the application as filed with the heading "*BRIEF DESCRIPTION OF THE DRAWING*" followed by the sentence "*Fig. 1 is a schematic process flow chart illustrating a typical embodiment of the present invention.*" and by the further heading "*DETAILED DESCRPTION OF THE PREFERRED EMBODIMENTS*". After this latter the features of the invention are described over more than two pages by making reference to the Figure.

In the Appellant's opinion, in particular the plural "*EMBODIMENT**S***" (emphasis added) in this latter heading would make it clear that this Figure is not just representative of a single embodiment of the invention, but rather represents a framework for the whole invention.

The Board concurs with the Appellant's interpretation only in part. Indeed, while it is convincing that Figure 1 is only a schematic process flow chart and, thus, does not give all possible details for all essential aspects of a single embodiment of the invention (such as that exemplified in Example 2 for the EB/SM distillation), still this fact only implies that the Figure and the corresponding description convey cumulatively information on a plurality of specific embodiments of the process and of the apparatus according to the invention, **which embodiments all have,** however**, the same combination of a plurality of**

technically relevant elements: i.e. it discloses directly and unambiguously a plurality of embodiments of the invention having in common the relevant features schematically reported in the Figure and emphasized in the corresponding description on pages 6 to 8. In particular, Figure 1 does not just imply by means of the "X" symbols the presence of the packing material in the CR columns for the EB/SM separation, but also the presence of the whole distillation train (inclusive of the two distillation columns preceding and following the CR columns for EB/SM separation), the presence of a certain number of reboilers in certain locations, and the fact that the product stream is fed to the middle region of each distillation column.

It is not relevant, in this respect, the fact that some of these features could appear more or less manifestly independent from the presence of a packing material or of trays in the columns. Indeed, even in the hypothetical case that the skilled person could make sound assumptions as to which of the features of Figure 1 are interdependent and which not, still the direct and unambiguous disclosure conveyed by this drawing and the corresponding description only defines a **combination of technically meaningful characteristics** which determine a preferred design option applicable to a plurality of specific apparatuses and processes according to the invention.

Hence, and since the subject-matter of claim 7 is not limited to the embodiments of the invention possessing all the technically relevant elements depicted in Figure 1 and in the corresponding description, also the teaching "d)" in original disclosure is found

insufficient for justifying the packing feature of this claim.

2.1.4 It remains to be considered if, as proposed by the Appellant, the skilled person would consider the packing feature directly and unambiguously disclosed by the combination of all the above-discussed teachings in the application as originally filed.

The Board is of the opinion that the combination of the same reasons indicated above which renders none of the alleged teachings "a)" to "d)" convincing *per se*, renders unconvincing this argument of the Appellant.

2.2 The Board therefore concludes that the wording "*packed with a packing material*", in the absence of the other technically relevant characteristics of Figure 1 - such as the use of all the reboilers reported in the Figure and the positioning of the feed inlets at the middle region of each distillation column - introduces in claim 7 as granted subject-matter that was not directly and unambiguously disclosed in the original application as filed. Hence, this claim does not comply with the requirements of Article 123(2) EPC and, therefore, the Appellant's main request to maintain patent as granted is not allowable already for this reason.

First auxiliary request

3. Added subject-matter in claim 5 (Article 123(2) EPC)

Even though claim 5 of the first auxiliary request further specifies the presence of the two additional distillation columns (see above section V of the Facts

and Submissions), still this claim is not limited to the embodiments of the invention possessing all the technically relevant elements reported in Figure 1. Hence the packing feature of the CR columns of this claim is found not based on the disclosure of the application as originally filed for substantially the same reasons given above for the corresponding feature in granted claim 7.

Accordingly, also this request is found to violate Article 123(2) EPC and, thus, not allowable.

Second auxiliary request

4. Added subject-matter in claim 1 (Article 123(2) EPC)

This claim is substantially identical to granted claim 7.

Accordingly, also this request is found to violate Article 123(2) EPC and, thus, not allowable for the same reasons given above for rejecting the main request.

Third auxiliary request

5. Added subject-matter in claim 1 (Article 123(2) EPC)

This claim is substantially identical to claim 5 of the first auxiliary request.

Accordingly, also this request is found to violate Article 123(2) EPC and, thus, not allowable for the same reasons given above for rejecting the first auxiliary request.

Fourth auxiliary request

6. Added subject-matter in claim 1 (Article 123(2) EPC)

Even though this claim further specifies the presence of the two additional distillation columns packed with packing material (see above section V of the Facts and Submissions), its subject-matter remains not limited to the embodiments of the invention possessing all the technically relevant elements reported in Figure 1. Hence, the packing feature of the CR columns of this claim is found not based on the disclosure of the application as originally filed for substantially the same reasons given above for the corresponding feature in granted claim 7 and in claim 5 of the first auxiliary request.

Accordingly, also this request is found to violate Article 123(2) EPC and, thus, not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Sauter L. Li Voti