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Datasheet for the decision of 7 December 2011

Case Number: T 1334/07 - 3.5.03

Application Number: 00984662.7

Publication Number: 1259554

IPC: C08F 10/02

Language of the proceedings: EN

Title of invention:
Process for the controlled production of polyethylene and its copolymers

Patentee:
Braskem S.A.

Opponent:
TOTAL PETROCHEMICALS RESEARCH FELUY S.A.

Headword:
Controlled production of polyethylene/BRASKEM

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (sole request) - no"

Decisions cited:
-

Catchword:
-

Case Number: T 1334/07 **-** 3.5.03

D E C I S I O N
**of the Technical Board of Appeal 3.5.03
of 7 December 2011**

Appellant: (Opponent)
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Representative: -

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 13 June 2007 concerning maintenance of European patent No. 1259554 in amended form.**

Composition of the Board:

Chairman: A. S. Clelland
Members: A. J. Madenach
R. Moufang

Summary of Facts and Submissions

I. The present appeal arises from the decision of the opposition division posted on 13 June 2007 according to which European patent No. 1259554 could be maintained in amended form.

The opposition was based on the grounds of Article 100(a), (b) and (c) EPC.

The opposition division came to the conclusion that account being taken of the amendments made by the patent proprietor during the opposition proceedings, the patent and the invention to which it related met the requirements of the Convention. They considered *inter alia* document

F1: US 5 844 054 A.

II. An appeal was filed against this decision by the opponent (appellant) with letter received on 31 July 2007. The appropriate fee was paid and the corresponding statement of grounds was filed. It was requested that the appealed decision be set aside and that the patent be revoked entirely. As an auxiliary measure, oral proceedings were requested.

III. With letter of 14 May 2009, the respondent (patentee) requested that oral proceedings be held.

IV. On 27 June 2011, the board summoned the parties to oral proceedings. Together with the summons, the board issued a communication under Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA) indicating the board's preliminary opinion, in particular with respect to the questions of inventive step and sufficiency of disclosure.

V. With letter of 8 November 2011 the respondent filed claims 1 to 25 and an amended description of a new main request. Maintenance of the patent on the basis of the amended set of claims was requested.

VI. The oral proceedings took place on 7 December 2011.

The parties confirmed their previous requests.

At the end of the oral proceedings the decision of the board was announced.

VII. Claim 1 according to the main and sole request which corresponds to claim 1 in the form as maintained by the opposition division reads as follows:

"A process for the controlled production of polyethylene and its copolymers in gas phase reactor(s), isolated or combined, under polymerization conditions, in the presence of hydrogen, oxygen, inert diluent(s) and chromium catalyst, wherein said process comprises the steps of:

a) In the laboratory, periodically testing the MFR1 MFRR and the density of the resin;

b) establishing the desired values or limits for the set of CVs and CCVs which comprises production rate, MFR1, MFRR and the density of the resin, catalyst productivity, opening of the temperature control valve, monomer partial pressure and superficial velocity of the gas in the reactor;

c) determining, in real time, the value of the variables cited in item b), the properties of the resin having their value continuously inferred with the aid of mathematical models;

d) establishing limits for the set of MVs which comprises flow rate of catalyst, ratio between the concentrations of one or more comonomers and ethylene, ratio between the flow rates of one or more comonomers and ethylene, temperature of the fluidized bed, ratio between the flow rates of oxygen and ethylene, ratio between the flow rates of hydrogen and ethylene, flow rate of the recycle stream, flow rate of inert diluent(s) and opening of the purge valve;

e) establishing limits for the variation rate of the variables of item (d);

f) using process mathematical models, simultaneously calculating the values which should be assumed under a stationary regimen by the variables cited in item d), considering that the level of the fluidized bed as well as the reactor pressure will be kept at constant values, so that the desired values set forth in b) will be reached without violating the limits established in items b) and d);

g) determining the sequence of adjustments, to be effected during a predetermined period of time, so that the variables cited in d) reach the desired values calculated in item f) considering the dynamics and the importance of each of the variables cited in b) as well as the constraints established in e);

h) adjusting the flow rates of catalyst, comonomer(s), cooling water, oxygen, hydrogen, inert diluents(s), the flow rate of the recycle stream and the opening of the purge valve so as to satisfy the previous items; and

i) based on the lab tests, periodically correcting the value which is inferred for the properties of the resin."

Reasons for the decision:

1. *Claim 1, novelty and inventive step (Articles 54 and 56 EPC):*

1.1 The present invention relates to a process for the controlled production of polyethylene and its copolymers. According to the respondent (patentee), the invention resides in using a specific set of variables in a mathematical process model of the production process. Control methods involving mathematical process models are generally known as model predictive control methods.

The patent in suit distinguishes between different classes of variables. Controlled variables are said to be "those variables the value of which should be kept the closest possible to a desired value or set point" (paragraph [0042]). Constrained controlled variables are "variables that, in spite of being controlled, do not need to have their value kept close to a set point. However, they should be controlled so as not to exceed certain limits" (paragraph [0044]).

Manipulated variables (MVs) are said to be "those which should be adjusted so that the controlled variables may be kept close to a set point or within certain limits. In order that a process variable is used as manipulated variable in a control strategy, the latter should somehow affect at least one controlled variable or a constrained variable. Examples of MVs are flow rates of monomer, catalyst and cooling water. In general, operators who follow the operation of a chemical process know, at least qualitatively, the way a certain MV affects a certain CV. It is usual to have some limit in regard to the variation rate of MV since for certain variables it may not be safe to promote large adjustments in a short period of time." (paragraphs [0045]-[0046] of the patent in suit).

A given variable may be a controlled and a manipulated variable at the same time, depending on the control loop being considered (paragraph [0049] of the patent in suit).

1.2 The board considers F1 as representing the closest prior art. This document discloses:

A process for the controlled production (column 1, lines 6-9) of polyethylene and its copolymers (column 2, lines 20-23) in gas phase reactors (column 2, lines 43-58) under polymerization conditions (column 1, lines 33-34), in the presence of hydrogen (column 3, lines 15-16), oxygen (column 1, lines 26-27), inert diluent(s) (column 2, line 58: "inert carrier gas") and chromium catalyst (column 1, lines 6-7).

Resin properties including the flow properties or melt index and resin density are periodically tested by laboratory methods (column 1, lines 24-25, column 6, lines 22-25, and column 8, lines 40-65). The testing of the flow properties or the melt index implies the testing of the melt flow rate and the melt flow rate ratio.

The process according to F1 mentions a number of variables, in particular: the amount of catalyst (column 1, lines 55-57), the molar ratios of the comonomers and thus the ratio between the concentrations of one or more comonomers and ethylene (column 3, lines 9-11), the reaction temperature which determines the temperature within the reactor and thus the fluidized bed temperature (column 1, lines 34-35 and column 3, lines 33-35), ratio between oxygen and ethylene (column 1, lines 55-60), ratio between hydrogen and ethylene (column 3, lines 15-16), flow rate of the recycle stream (column 2, lines 53-55 and column 4, lines 5-8), flow rate of inert diluents (column 2, lines 53-58), opening of the purge valve (column 4, lines 5-8). The process according to F1 involves the further variables: the reactor pressure, the production rate (column 1, lines 34-42), and the velocity of the gas in the reactor (column 2, line 54).

With respect to the fluidized bed temperature, the board notes that F1 gives a possible range of temperatures from 10 to 130 degrees C (column 3, lines 33-35). Chemical reactions and the properties of the materials obtained by such a process, including the claimed polymerisation process and the resin flow properties of the resulting resin, are well known to depend strongly on the process temperature (F1, column 5, lines 55-60) which, in this case, corresponds to the reactor temperature. Thus, even if there is no explicit statement to this effect in F1, the fact that the temperature may be varied has a consequence that the reactor temperature is a manipulated variable in the sense of the patent.

With respect to the hydrogen/ethylene molar ratio, F1 states (column 3, lines 15-16) that the hydrogen/alpha-olefin (to which group ethylene belongs) molar ratio can be adjusted to control average molecular weights (see also column 4, lines 2-4). According to the board's understanding, molecular weights determine inter alia the resin flow properties. The molar ratio is adjusted by adjusting the hydrogen/alpha-olefin ratio (column 3, lines 16-21 and lines 61-64). Thus, the hydrogen/ethylene molar ratio is (at least implicitly) used as a manipulated variable in the sense of the patent.

The amount of catalyst and oxygen/ethylene ratio are explicitly mentioned as manipulated variables in the sense of the patent (column 1, lines 44-57). The same applies to the comonomer/ethylene ratio (column 3, lines 9-11) and the opening of the purge valve (column 4, lines 5-8).

With respect to the flow rate of the recycle stream, the board notes that the recycle stream comprises according to Figure 3 of the patent the basic monomers (streams 1 and 9), other constituents (stream 10) and recycled materials (part of stream 7). According to F1, the reactor comprises a vent through which gases leave the reactor and which is computer controlled (column 4, lines 5-8). Gases having left the reactor are recycled into the reactor (column 2, lines 55-58). The gases entering the reactor, including the recycle stream, clearly determine the controlled variables such as the resin flow properties (this in fact follows from the teaching of the patent itself). Therefore, the recycle stream must be considered a manipulated variable in the sense of the patent. The same applies to the flow rate of inert diluents (*ibidem*).

Of the variables mentioned in F1, production rate and resin properties such as flow rate and density are generally controlled parameters in any polymer production process such as that of F1 (column 1, lines 24-25).

Following column 1, lines 38-39, the amount of catalyst is a constrained controlled variable. The board notes in this context that according to column 3, lines 5-8 it is rather the catalyst productivity obtained by activation of the available amount of catalyst which is relevant to the process. Thus, the catalyst productivity is to be considered a controlled variable for the process in F1.

Furthermore, according to column 1, lines 31-36, the reaction temperature is controlled. This implies controlling the opening of the temperature control valve which determines the reaction temperature. From the same passage follows that the reactor pressure is controlled.

The bed is fluidized *inter alia* by modifying gaseous components at a flow rate and velocity sufficient to act as a fluid (column 2, lines 49-55). The superficial velocity of the gas in the reactor must thus be considered a controlled variable.

The reactor pressure (see above) together with the oxygen to alpha-olefin molar ratio (column 1, lines 38-39) and the gaseous composition (column 2, lines 53-54), which are all controlled variables, determine the monomer partial pressure, which is, thus, also a controlled variable in the process of F1.

Variables (including the properties of the resin) are controlled through predictive computer models and coordinated control methods (column 7, lines 18-20). Based on the results, the variables are adjusted (column 1, lines 58-60; column 3, lines 9-16 and column 4, lines 33-34).

As an inherent property of the control method of F1, the manipulated variables are adjusted in such a way that the controlled and constrained controlled variables reach the desired values, as recited at point g of claim 1.

1.3 The process according to claim 1 differs from the known process in that:

i) Manipulated variables involve the **flow rate** of catalyst, the ratio between the **flow rates** of one or more comonomers and ethylene, the ratio between the **flow rates** of oxygen and ethylene, and the ratio between the **flow rates** of hydrogen and ethylene instead of the fixed amounts of these quantities as in the process of F1.

ii) A stationary regimen with a constant fluidized bed level and constant reactor pressure is assumed for the calculation of the controlled and constrained controlled variables using process mathematical models, and

iii) a particular subset of manipulated variables and controlled and constrained controlled variables used in the process mathematical models is specified.

The subject-matter of claim 1 is therefore new compared to the process known from F1.

1.4 With respect to the above difference ii), the board notes that the controlled production of polyethylene on an industrial scale is a very complex process as is evident from the numerous parameters influencing the process as disclosed in F1. Considering the complexity of such a process, it is obvious to the skilled person to model the process, at least as a first attempt, with certain variables fixed, *i.e.* stationary, in order to avoid further complexities arising in dynamic modelling of the process. For this reason, the skilled reader of F1 would, in the absence of an indication to the contrary, assume that the process control disclosed therein is for a stationary regimen. For the same reasons, it would also have been obvious to keep the key parameters of the fluidized bed level and the reactor pressure constant.

The respondent did not in fact deny that feature ii) was obvious to the skilled person.

As a consequence of the process being a stationary process, the parameters: flow rate of catalyst, ratio between the flow rates of one or more comonomers and ethylene, ratio between the flow rates of oxygen and ethylene, and ratio between the flow rates of hydrogen and ethylene, are implied by the amount of catalyst, the molar ratios of the comonomers and thus the ratio between the concentrations of one or more comonomers and ethylene, the ratio between oxygen and ethylene, and the ratio between hydrogen and ethylene.

Thus, feature i) follows as a consequence of the modelling of the process as a stationary process.

As a result, all the claimed parameters are, under this assumption, known from F1.

The above findings concerning features i) and ii) were essentially not contested by the respondent (see page 4, penultimate paragraph, of the letter of 8 November 2011).

1.5 Concerning feature iii), it follows from the preceding considerations that the controlled variables, constrained controlled variables and manipulated variables as claimed are, if not identical to the variables considered for the process of F1, at least obvious to the skilled person.

At this point, the board observes that claim 1 defines the controlled and constrained variables as well as the manipulated variables as **comprising** the variables listed for each group. As a consequence, the process mathematical models, which are said to calculate the cited manipulated variables in order reach the desired values of the controlled and constrained controlled variables, can comprise any super- or subset of the variables listed in the claim.

Hence, the only difference as regards feature iii) results from difference ii). Following the reasoning set out above at point 1.4, feature iii) would have been obvious for the skilled person.

1.6 The respondent's central argument was that the invention lies in the determination of specific sets of such process variables as the basis for formulating mathematical models by which a relatively simple but effective control strategy can be achieved (see page 3, central paragraph, and page 4, penultimate paragraph, of the letter of 8 November 2011).

This argument is unconvincing since the open claim language does not restrict the mathematical process models exclusively to exactly those variables listed in the claim.

In support of its argument, the respondent argued that various parts of the description would point the skilled reader to understanding the claim as being directed to essentially just the listed variables, *e.g.* paragraph [0050] of the patent specification "it is the right choice of said variables which determine the scope of the control system as well as the potential benefits from its use in a controlled process".

The board notes that the description of the patent in suit does not provide an unequivocal teaching that only the parameters listed in the claim for the process mathematical models are to be considered. Reference is made to page 6, lines 19-20 of the patent in suit according to which the classification of parameters depends on the control loop considered. Since the patent does not specify a specific control loop, the skilled reader will not give the claim a narrow interpretation since this could only be justified on the basis of a specific control loop for which, as noted, no disclosure has been provided.

The respondent's argument is accordingly not considered plausible.

Furthermore, even if it were assumed - *arguendo* - that the process mathematical models are restricted to the listed parameters, the board observes that in F1, apart from minor deviations (see point 1.4 above), essentially the same parameters are considered as important for the process. In the absence of any teaching that specific parameters must be used in the predictive computer models, it would have been obvious for the skilled person to consider predictive computer models comprising the various parameters considered in F1, thus arriving at the claimed invention without inventive activity.

1.7 From the above follows that the subject-matter of claim 1 of the sole request does not involve an inventive step, contrary to the requirements of Article 56 EPC.

2. Since claim 1 of the sole request does not comply with the requirements of Article 56 EPC, the request cannot be allowed. It is accordingly unnecessary for the board

to consider whether the request complies with the other requirements of the EPC.

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

G. Rauh A. S. Clelland