Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 20 February 2019

Case Number: T 1088/16 - 3.3.03

Application Number: 06024952.1

Publication Number: 1927626

IPC: C08L23/02

Language of the proceedings: EN

Title of invention:
Multimodal polyethylene resin for pipe made by a single-site catalyst

Patent Proprietor:
Borealis Technology Oy

Opponent:
THE DOW CHEMICAL CO.

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
Novelty - (yes) - all requests
Inventive step - (no) (all requests)

Decisions cited:
T 0793/93

This datasheet is not part of the Decision.
It can be changed at any time and without notice.

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1088/16 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 20 February 2019

Appellant: (Patent Proprietor)	Borealis Technology Oy P.O. Box 330 06101 Porvoo (FI)
Representative:	Kador & Partner PartG mbB Corneliusstraße 15 80469 München (DE)
Respondent: (Opponent)	THE DOW CHEMICAL CO. 2030 Dow Center Midland, Michigan 48674 (US)
Representative:	Boult Wade Tennant LLP Verulam Gardens 70 Gray's Inn Road London WC1X 8BT (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 29 February 2016 revoking European patent No. 1927626 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	D. Semino
Members:	M. C. Gordon
	C. Brandt

Summary of Facts and Submissions

I. The appeal of the patent proprietor lies against the decision of the opposition division posted on 29 February 2016 revoking European patent number 1 927 626.

II. The patent was granted with a set of 13 claims, whereby claim 1 read as follows:

"A polyethylene composition comprising a polyethylene base resin, which comprises

a. an ethylene copolymer as fraction (A), and
b. an ethylene homo- or copolymer as fraction (B),

with fraction (A) having a lower molecular weight than fraction (B), wherein the polyethylene base resin is obtainable in a polymerisation process in which a single-site catalyst (SSC) is used in the polymerisation of at least one of fractions (A) and (B), and the base resin has

(i) a density of below 940 kg/m^3 ,
(ii) a MFR_2 at 190 °C / 2.16 kg of 0.01 to 10 g/10 min
and the composition has
(iii) a flexural modulus of from 400 to 820 MPa."

III. A notice of opposition against the patent was filed in which revocation of the patent on the grounds of Article 100(a) EPC (lack of novelty, lack of inventive step) and Article 100(b) EPC was requested.

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

D3: WO-A-2005/095509
D4: WO-A-2003/033586
D5: US-A-5 338 589
D7: WO-A-03/020821
D11 and D11a: Experimental reports submitted by the opponent in respect of D7
D23: Handbook of Polyethylene (Peacock, A. J.), Marcel Dekker, 2000, pp. 123-133, 147, 148.

IV. The decision of the opposition division was based on the claims of the patent as granted as main request and four sets of claims as first to fourth auxiliary requests.

According to the decision the main request complied with the requirements of sufficiency of disclosure and novelty, but was not founded on an inventive step.

All auxiliary requests were held to contain subject-matter extending beyond the content of the application as originally filed.

V. The patent proprietor (appellant) filed an appeal against the decision, pursuing as the main request rejection of the opposition, i.e. maintenance of the patent as granted. Sets of claims forming first to third auxiliary requests were submitted with the statement of grounds of appeal.

Further documents were cited *inter alia*:

D26: German, P.M. "Metallocene Linear Low-Density Polyethylene", ExxonMobil Chemical Company; Publ. blownfilmtech.com/ebooks/Free/m-LLDPE.pdf 2011

D27: Gupta, P. Thesis 2004 Part II.

VI. In its reply the opponent (respondent) submitted further documents:

D28: WO-A-94/26816
D29: US-A-5 281 679
D30: Test report of Wang, J.
D31: EP-A-1 462 464.

Objections in respect of insufficiency of disclosure, lack of novelty and lack of inventive step were maintained for the main request (claims of patent as granted).

Objections of added subject-matter and lack of inventive step were raised in respect of all auxiliary requests.

VII. The Board issued a summons to oral proceedings.

In the preliminary view of the Board, the claims of the main request met the requirements of sufficiency of disclosure and novelty, but not those of inventive step.

All auxiliary requests were additionally addressed as far as the issue of added subject-matter was concerned.

VIII. The appellant made further written submissions with letters of 22 August 2018, 17 September 2018 and 17 January 2019.

Auxiliary requests 1, 1a (letter of 22 August 2018), and auxiliary requests 2, 2a, 3 and 3a (with letter of 17 January 2018, replacing requests with the same

designations filed with the letter of 22 August 2018) were submitted. The "a" series of requests differed from the other requests in that claim 2, had been deleted.

Claim 1 of auxiliary request 1 differed from claim 1 of the main request in that:

- The density of fraction A was specified - 925 to 945 kg/m^3
- MFR_2 of the base resin was 0.10 to 0.50g/10 min
- Shear thinning index $SHI_{(2.7/210)}$ was specified as being below 20
- Flexural modulus was 450 to 650 MPa.

In claim 1 of auxiliary request 2 the following further restrictions were made:

- The density of fraction A was defined as 925 to 940 kg/m^3
- It was required that fractions (A) and (B) were polymerised using the same single-site catalyst
- The density of the base resin was from 920 to below 939 kg/m^3
- $SHI_{(2.7/210)}$ was below 10.

In claim 1 of auxiliary request 3 the following further restriction compared to auxiliary request 2 was made:

- The MFR_2 (190°C/2.16 kg) of fraction A was specified to be between 50 to 140 g/10 min.

IX. The respondent made further written submissions dated 24 July 2018 and 5 September 2018. Together with the latter, a further document was submitted:

D32: Chu *et al* Macromol. Chem. Phys. 201, No. 3, 2000,

pp 240-248.

X. Oral proceedings took place before the Board on 20 February 2019.

XI. The arguments of the appellant can be summarised as follows:

(a) Admittance of documents D28, D29 and D32

These had been filed in answer to D26 and D27, but added nothing compared to these.

D28 and D29 did not demonstrate what the respondent alleged in respect of the (non)suitability of the product-by-process definition as a characterising or distinguishing feature. On the contrary, these documents confirmed the information provided by D26 and D27. Even in the case as set out in D29 that a single site catalyst (hereinafter "SSC") was designed so that it largely mimicked the behaviour of a Ziegler Natta (hereinafter "ZN") catalyst there would still be identifiable polymer properties which would permit reliably to ascertain the nature of catalyst system used.

(b) Main request - novelty - D5 and D7

Regarding the alleged derivation of flexural modulus from Young's Modulus properties at best only a rough estimation was possible.

A plurality of selections from the disclosure of D5 was required in order to assemble the subject-matter claimed. Neither the description nor the examples of D5 provided an unambiguous disclosure

of the low molecular weight (hereinafter "LMW") fraction being a copolymer. It was also not disclosed that the LMW fraction had been prepared by a SSC catalyst which was to be seen as a distinguishing feature. Although - as shown by D32 - inspection of a single property would not necessarily permit the type of catalyst used to be identified, consideration of a plurality of properties would yield unambiguous information about the nature of the catalyst.

Similarly, within the disclosure of D7 a plurality of selections was required to arrive at the LMW polymer. There was no general disclosure of the flexural modulus or the density, and the example compositions had a density outside the claimed range. The flexural modulus in D7 was measured by a different method to that required by the patent. It was not even possible to rework D7 since the disclosure thereof was incomplete, meaning that the data of the respondent submitted in respect thereof (D11, D11a) had to be seen as speculative.

(c) Main request - inventive step

The invention related to pressure pipes for water which was the same field as in D7. Such pipes had to comply at least with standard PE63 as set out in the patent. The pipes required a combination of density, flexibility and processability, between which properties there was a trade off. The problem addressed by the patent was to provide further compositions suitable for providing pipes having increased flexibility whilst meeting the PE63 standard. In contrast, D5 related to gas pipes for which flexibility was not an issue.

The claimed subject-matter was distinguished from the disclosure of D7 by the flexural modulus and the preferred density range which overlapped with the lower end the range of D7 whereby the density of the composition exemplified was above the required range. The examples of the patent confirmed that the indicated problem was solved.

There was no hint in D7 to the claimed solution. Even if the technical problem were to be formulated as the provision only of a further composition it would not be obvious to achieve this by lowering the density since the expectation would be that this would impair other properties. This was confirmed by the results of D11, notwithstanding that this was not prior art.

Regarding D5 this would not, in combination with D7, lead to the subject-matter claimed. D5 was concerned with the provision of gas pipes, not pressure pipes for water, related to a different - trimodal - composition, was not concerned with flexibility and furthermore confirmed that resins with lower density led to poorer pressure resistance.

(d) Auxiliary requests 1 and 1a - inventive step

Due to the amendments made there were now five distinguishing features compared to D7:

- the density of LMW fraction A only overlapped at the single point of 945 kg/m^3 with that of D7 and the preferred range was distinct and lower;

- the specified density of the base resin of below 940 kg/m^3 only partially corresponded to that of D7;
- the specified MFR_2 of the base resin of 0.1-0.5g/10 mins was narrow compared to the range of 0.1-10 g/10 mins disclosed in D7;
- the specified values of flexural modulus in D7 was higher than that specified and had been obtained by a different measurement method;
- the SHI was not disclosed in D7.

The examples of D7 polymerised the fractions in the opposite order to that specified by the patent and the nature of the catalyst employed was not clear.

The comparative example of the patent corresponded to the teachings of D7. Whilst D7 required a large difference in the density of the two fractions the evidence of the patent was that when employing a SSC catalyst it was possible to have the densities of the fractions much closer and still maintain the required pressure resistance. In view of the catalysts used for the second stage of the example of D7 it was to be assumed that the SHI was not as low as required by the operative claims.

The objective problem was to provide different compositions having improved flexibility but meeting the PE63 standard. There was no suggestion in D7 that flexibility could be improved whilst maintaining pressure resistance by means of compositions with the claimed property profile. Even considering the problem of providing only an alternative composition the subject-matter claimed could not be seen as obvious - none of the 5 modifications made compared to D7, let alone their

combination, was derivable from the prior art. Regarding specifically the SHI, even if this parameter was almost exclusively used by the patent proprietor, it was nevertheless a well established parameter and was known to be correlated to and a reflection of the MWD. It provided a meaningful further definition of the subject-matter claimed with respect to the breadth of the MWD.

The position with respect to D5 was similar with the difference that the density of the LMW fraction was below the claimed range. There was no disclosure of the density of the base resin - only that of compositions containing up to 10% of additives was reported. Similarly the MFR_2 of the base resin was not disclosed, only that of the composition. The SHI, which was controlled by the catalyst, was not disclosed and a SSC was not employed. Thus it could not be assumed that this requirement was satisfied. Similarly only Young's modulus, not flexural modulus was disclosed.

(e) Auxiliary requests 2 and 2a - inventive step

The same as arguments as indicated for the previous requests applied.

(f) Auxiliary requests 3 and 3a - inventive step

The amendment to MFR_2 of fraction A increased the distinction with respect to both D5 and D7. There was no pointer to this specific combination of features. The selection of the defined two fractions allowed for an optimisation of the properties of processability (LMW fraction) and pressure resistance (High molecular weight -

hereinafter "HMW" - fraction). None of the prior art documents pointed to this combination as a solution to the indicated problem.

XII. The arguments of the respondent can be summarised as follows:

(a) Admittance of documents D26-29, D31, D32.

No objections were raised to the admittance of D26 and D27 submitted by the Appellant.

D28 and D29 had been submitted in response to D26 and D27. There had been no opportunity or reason to submit these earlier in the proceedings.
The objections of the appellant to the admittance of D28 and D29 related to the technical content, not to their *prima facie* relevance.

Similarly no objection had been raised in respect of appellant's D31; instead D32 was submitted in reaction thereto.

(b) Main request - novelty

D5 examples 1-3 disclosed all features of claim 1 except the flexural modulus. The reported property of Young´s modulus was sufficiently correlated with the flexural modulus that it could be estimated that the value thereof fell within the range required by the claims. In addition the absence of a measurement method of flexural modulus in the claim meant that any method could be applied with the consequence that a large variance had to be applied in interpreting this value.

The specified nature of the catalyst could not represent a distinguishing feature.

Documents D26 and D27 stated that SSC catalysts yielded polymers having a property profile which was distinct from that arising from use of ZN catalysts. However D28, D29 and D32 demonstrated this was not necessarily the case - there were wide variations possible within SSC catalysts and these could be designed to mimic the effect of ZN catalysts.

Since the patent provided no definition of what was meant by SSC beyond a reference to a further document (D31) this feature could not be relied upon to characterise the composition.

D7 explicitly disclosed a SSC. Formally the density specified in claim 1 - below 940 kg/m^3 - provided a distinction over the composition exemplified in D7, which had a lower density limit of 940 kg/m^3, however technically this could not be seen as a distinction. Whilst it was not possible to reproduce the examples of D7 completely, this was possible to the extent that it could be shown that following the teachings of D7 would result in compositions which inevitably fell within the scope of the claims.

(c) Main request - inventive step

If D7 were taken as the closest prior art, the flexural modulus was not necessarily a distinguishing feature as it was unknown in D7. Hence it was merely a matter of arbitrarily selecting a value for this property.

The examples of the patent differed from each other in too many respects for it to be possible to ascertain whether any effect arose from any particular feature. Hence the problem was to provide an alternative composition.

D11 and D11a were irrelevant since these were not prior art and could not serve to inform the skilled person about modifications to make.

Regarding the flexural modulus and assuming, for the sake of argument, that that of the D7 compositions was too high, it would be obvious to adjust this by lowering the density. This relationship was well known as confirmed by D23 and acknowledged in the patent. The reliance in the arguments on a particular pressure standard mentioned in the description was not relevant since the claim did not specify this. In any case the hoop stress reported in D7 was sufficiently high that there was scope to reduce the density without reducing the pressure resistance to below the required standard.

The teaching of D5 was also relevant - a service life for the pipe was mentioned and it was not possible to say this did not correspond to the standard referred to in the patent.

As there was no evidence for any technical effect arising from the sole distinguishing feature - formally the density - the objective problem had to be formulated as the provision of further compositions suitable for pipes regardless of meeting any particular requirements, which problem

was solved in an obvious manner by adjusting the density.

The appellant had not shown that in the quest for alternative compositions, to provide pipes broadly meeting the requirements of D5, there was no leeway based on the teaching of D5 to adjust the density. Such adjustment would be within the ability of the skilled person, also considering that the operative claims imposed no limitation in respect of a particular pressure standard to be met.

(d) Auxiliary requests 1 and 1a - inventive step

The density of the base resin could not be regarded as a distinguishing feature meaning that there were only 4 differences.

As previously observed, no conclusions as to effects deriving from the distinguishing features could be made on the basis of the (comparative) examples of the patent.

Regarding the density of the LMW fraction being lower than that of D7, this would be obvious in order to accomplish the goal of reducing the density of the overall composition. Similarly for the MFR - insofar as this could be considered a distinguishing feature over the most preferred range of D7 - no effect had been shown and hence represented only an arbitrary modification.
The SHI - which was correlated with MWD - was not reported in D7. However this was a parameter that was used almost exclusively by the patent proprietor and had to be seen as an unusual parameter. Nevertheless, as shown by D11a the

values reported did not themselves appear to be exceptional and there was no evidence that the specified range necessarily implied differences in the properties of the compositions.

The specified value of flexural modulus constituted a desideratum, and there was nothing exceptional about the range specified.

Regarding D5 although in the examples the densities were generally somewhat too low, the claims allowed densities up to 925 kg/m^3 meaning that there was no reason not to operate in this range.

(e) Auxiliary requests 2, 2a, 3 and 3a - inventive step

The same arguments applied as indicated for the previous requests.

XIII. The appellant requested that the decision under appeal be set aside and that the opposition be rejected, i.e. the patent be maintained as granted, in the alternative, that the patent be maintained in amended form in the basis of one of the sets of claims according to auxiliary requests 1, 1a, as filed with letter dated 22 August 2018 or on the basis of auxiliary requests 2, 2a, 3 or 3a as filed with letter of 17 January 2019. It was also requested that none of the documents D28, D29 and D32 be admitted into the proceedings.

XIV. The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Status of documents cited in the procedure

1.1 D26, D27 (Appellant), D28, D29, D31, D32 (Respondent) - Admittance

D31 is cited in paragraph [0042] of the patent in suit in respect of the single site catalyst to be used. Insofar as this document is presented in the patent as an integral part of the disclosure, and its admittance is not contested, its content is *de facto* in the procedure.

D26 and D27 had been cited by the appellant with the statement of grounds of appeal in order to address the findings of the decision in respect of the question of whether the definition of the catalyst could serve as a characterising feature of the product (minutes of the oral proceedings before the opposition division, section 3, second and fourth paragraphs; decision, section 2.3 of the reasons; statement of grounds of appeal, section 5.2).

The respondent did not object to the citation of these documents but instead provided further documents in response, i.e. D28, D29, and D31 submitted with the rejoinder to the statement of grounds of appeal and D32 submitted with a subsequent letter.

The Board is satisfied that the submission of these documents by the respective parties was a direct response to a matter central to the decision under appeal and submissions in the appeal proceedings.

It has not been rendered credible by either party that

there would have been a reason to submit such documents at any earlier stage of the procedure (cf. Article 12(4) RPBA).

The arguments of the appellant regarding the documents invoked by the respondent, i.e. D28, D29, D31 and D32 are directed not to demonstrating that these are *prima facie* not relevant, but on the contrary enter into a detailed discussion and analysis of the respective teachings to establish whether they in fact demonstrate what the respondent states (appellant's letter of 22 August 2018, pages 10-13 in respect of D28 and D29 and the entirety of the letter of 17 September 2018, regarding all of D28, D29 and D32). To the extent that a detailed analysis of these documents was undertaken it is not possible to conclude that it has been shown that these are *prima facie* not relevant. On the contrary appellant has by means of the detailed discussions advanced in effect admitted the documents to the procedure.

Accordingly the Board can identify no reason to exclude any of D26, D27, D28, D29, D31 or D32 from the procedure.

1.2 D30 - experimental report submitted by respondent - admittance

This report was cited to address the findings of the decision in respect to the question of whether the flexural modulus was disclosed by the cited documents (decision under appeal, section 2.4), and hence can be seen as directed to addressing a finding of the opposition division. No objection against its admittance was raised by the appellant.

Accordingly the Board can identify no reason to exclude this document.

1.3 In summary, documents D26 to D32 are admitted into the proceedings.

2. Main request

2.1 Novelty

2.1.1 D5

D5 relates to polyethylene moulding compositions which are blends of high density polyethylene (HDPE) and linear low density polyethylene (LLDPE), which according to claim 1 have:

- a density of 0.930 to 0.940 g/cm^3
- a MFI(MFR) 190/2.16 of 0.05 to 1.0 g/10 min
- having 50-80 wt.% of HDPE having a density of 0.940-960 g/cm^3, a MFI 190/2.16 of 0.01 to 0.5 g/10 min, a broad bimodal molecular weight distribution, wherein the HDPE is produced by a two-stage polymerisation process, the product of the first stage having *inter alia* a density of 0.910 to 0.925 g/cm^3 and MFI 190/2.16 of 0.5 to 2.0 g/10 min.

According to claim 4 the first - HDPE - component can be a copolymer.

In Table 3 (columns 5 and 6) Examples 1-3 are reported, indicating among the properties given Young's modulus of the compositions.
In the examples of D5 a ZN catalyst system is used for

preparation of the HDPE component (column 1, lines 66-67).

Regarding examples 1-3, which were invoked by the respondent, reference can be made to Table 3 of D5:

TABLE 3

Characteristic		Test method	Example 1	Example 2	Example 3
Density	g/cm^3	DIN 53479	0.938	0.935	0.935
VN	cm^3/g	ISO/R 1191	290	270	260
MFI 190/2.16	g/10 min	DIN 53735	0.23	0.30	0.31
MFI 190/5			0.93	1.13	1.15
MFI 190/21.6			18.2	19.0	18.6
MFR 21.6/5			19.6	16.8	16.2
Young's modulus	MPa	DIN 53457-t	643	636.4	618.4
Flexural creep modulus	MPa	DIN 54852 (1 min)	804	766	751
Yield stress	MPa	DIN 53455 ISO/R 527	19.9	18.7	18.6
Elongation at yield stress	%	125 mm/min	9.1	11.6	10.3
Tear strength	MPa	Test piece 3	38.6	34.7	37.5
Elongation at break	%		793.7	740.0	749.7
a_n					
23° C.	mJ/mm^2	Notched impact strength	18.8	n.f.**	n.f.**
0° C.		U-notch DIN 53453	16.1	28.6	36.6
−20° C.		(Pressed standard small rod)	10.4	13.2	13.5
Bell test 100° C.	h	ASTM D 1693 C	>1000	>1000	>1000
Tear test 80° C.	h	5 MPa, glycol	379 ± 128	>2000	>2000
OIT 200° C.	min	ISO/TC 138	48	28.5	23.6

*Resistance to stress cracking: service like of samples of square cross-section notched all round
**No fracture

These examples are based on a bimodal HDPE, which was prepared by a ZN process (column 1, line 62 - column 3, line 3, column 4 lines 9-69) and two different LLDPEs. In example 1 a unimodal LLDPE but-1-ene/4-methylpent-1-ene/ethylene terpolymer was employed whilst in examples 2 and 3 the LLDPE was an oct-1-ene/ethylene copolymer having a unimodal molecular weight distribution (MWD) as well as further additives.

Thus the LLDPE of the indicated examples of D5 reflects fraction A of operative claim 1 and the HDPE reflects fraction B.

On the basis of the reported properties - see Table above - it is established that, as required by the operative claim, the copolymer fraction is of lower

molecular weight than the homopolymer fraction (higher MFI at two different loadings), and that the density of the total composition and the MFR thereof are within the ranges required.

Two features of the operative claims are not explicitly disclosed in the examples of D5:

- insofar as the preparation of the polymers was disclosed, this was on the basis of ZN catalysis, not by means of a SSC.
- the flexural modulus is not reported, instead Young's modulus is given.

(a) Regarding the product-by-process feature "in which a single-site catalyst (SSC) is used in the polymerisation of at least one of the fractions (A) and (B)" it was the position of the appellant that this provided a distinguishing feature.

For the following reasons the Board does not share this view.

According to D26, introduction, second paragraph, the first paragraph in the section "Polymer Characterization" and the second paragraph on the third page of the document, metallocene (SSC) prepared LLDPEs exhibit narrower MWD and more uniform comonomer distribution than "conventional" LLDPEs (i.e. those prepared with ZN catalysts). In the final paragraph of the third page it is stated that metallocene prepared LLDPE has improved toughness.

A similar teaching can be derived from D27, page 173 second paragraph in section 1.1 which states that LLDPE prepared with ZN catalysts exhibit

considerable heterogeneity in their microstructure and melting behaviour, and that the resulting polymers are considered to be a mixture of fractions of polyethylene copolymers with a range of molecular weights and short chain branch content. This is contrasted with SSC prepared polymers which have a narrow molecular weight distribution and more homogeneous distribution of short chain branches.

Thus according to what may be derived from D26 and D27 the two different catalysts result in - detectably - different polymers.

However according to D28, page 3 lines 1-5 the outcome of polymerisation with SSC depends on whether they are used in supported or unsupported form. Thus supported SSC lead to LLDPE having broader Composition Distribution Breadth Index (CDBI) and MWD than unsupported SSC. This is confirmed in the final partial paragraph of page 4, where it is also stated that the CDBI of SSC prepared resins is **generally** (emphasis of the Board) narrower than that of copolymers prepared using ZN catalysts. According to D28, page 8, 3rd complete paragraph, the LLDPEs have CDBI generally in the range of 50-90%, usually 55-85%. According to page 12, second complete paragraph and Table V SSC prepared polymers have narrower MWD and at equivalent melt index, lower Mw, Mz and Mz+1 than ZN prepared catalysts.

However according to D29, although these trends are generally confirmed - column 20, lines 20-24 - the purpose of the document is to prepare polymers with broadened MWD and CDBI despite using SSC (column 1,

lines 14-23, statements of problem in columns 2 and 3 and the summary of the invention, first three paragraphs). This document demonstrates that it is possible to adjust SSC systems to mimic the properties arising from ZN catalyst.

Although operative claim 1 does not provide any definition of the catalyst, the patent contains in paragraphs [0042] and [0079] a reference to D31 for the purposes of defining the SSCs to be used. Claim 1 of this document provides only a very general, broad definition of the catalyst. Indeed this broad definition encompasses the catalysts of D29, which as noted above, can mimic the results obtained with ZN catalysts.
Hence even assuming - in favour of the appellant - that the term "SSC" would be understood as denoting one of those disclosed in D31 this still would not impose any restriction in terms of the properties of the resulting polymers which would necessarily and reliably establish a distinction over polymers prepared under action of another type of catalyst, in particular ZN.

D32 is directed to an investigation of different *in situ* supported SSCs. Figure 3 demonstrates that, depending on the precise nature of the catalyst, widely differing distributions of comonomer throughout the molecular weight spectrum of the polymer result, as shown by the Crystaf profiles. This diagram shows that either a rather narrow distribution can be obtained, or at the other extreme a distribution with three peaks. Similarly Figure 2 and Table 1 of D32 provide evidence for wide variations in the MWD and a significant difference in the length of the low molecular

weight tails depending on the catalyst employed.

The conclusions that are to be drawn from the documents provided by the parties (D26, D27, D28, D29, D31 and D32) is that whilst in a direct side by side comparison it may well be possible to ascertain which of two otherwise identical polymers had been prepared by a particular type of catalyst system, the variations that are possible with SSC are so broad, extending even to mimicking the outcome obtained with a ZN catalyst that it has not been credibly shown that on the basis of an isolated polymer with no reference material it would be possible unambiguously to determine by which means the polymer had been prepared. Hence it cannot be concluded, that the feature "obtainable by" a SSC is suitable to characterises the polymer.

Accordingly this "product-by-process" feature cannot serve as a distinguishing feature compared to the prior art.

(b) Flexural modulus

In the context of D5 the question to be addressed is whether, based on the disclosure of Young's modulus, the flexural modulus can be derived. As an aside, the Board notes that, in contrast to the "product-by process" feature it has not been disputed that the flexural modulus is suitable and appropriate to characterise the subject-matter claimed.

The respondent has provided an analysis, based on the data plotted in D30, with which the correlations between the flexural and Young's

moduli and density are shown. These data are derived from two of the documents cited in the procedure - D3 and experimental report D11, as well as the patent and a study conducted by the respondent. It is argued that, given certain information about the polymer, e.g. one modulus, it is possible to determine whether the flexural modulus will fall within the range claimed.

The provided data show plots of the relationships between flexural modulus and density; Young's (E) Modulus and density; and flexural and Young's moduli. Although in all cases there is a broadly linear relationship, this is subject to variability, as indicated by the degree of scattering in the plots.

These data demonstrate at most that given one of the moduli it is possible - within a broad approximation - to estimate the other.

It is recalled that the Case Law of the Boards of Appeal applies a very strict standard of proof in respect of novelty namely "beyond all reasonable doubt" (T 793/93 of 27 September 1995, see the catchword specific to the case of what is or is not the inevitable outcome of an express literal disclosure which clearly applies here). To the extent that the correlations adduced by the respondent are demonstrably subject to variability and uncertainty (scattering), it cannot be concluded that the arguments based thereon can serve to establish - to the required standard - the corresponding properties of the compositions of the cited documents.

Accordingly it has not been shown that the examples of D5 disclose compositions having the required flexural modulus.

Consequently the subject-matter of claim 1 is not anticipated by the disclosure of D5.

2.1.2 D7

The sole example of D7 does not formally disclose the required density (a value of 940 kg/m^3 is disclosed while a value below 940 kg/m^3 is required in claim 1), and the flexural modulus value has a reported value that is above the range required (955 MPa vs a value from 400 to 820 MPa in claim 1) which moreover has been determined by a different method to that set out in the patent. With D11 and D11a the respondent has stated that it has provided replications of the teaching of the example of D7. However the Board observes that many details of the examples, e.g. catalysts used, reaction conditions etc. are not disclosed in D7, meaning that various assumptions have to be made. The respondent has submitted that it has provided a cluster of examples within the ambit of what is explicitly disclosed in D7 and that the conclusion to be reached from these is that the subject-matter claimed is anticipated.

However, since there are a number of details lacking from D7 it is inherently impossible to replicate the teaching thereof and accordingly any attempt to do so is condemned to failure in the light of the high standards set by the Case Law of "beyond all reasonable doubt" (i.e. the inevitable outcome of the disclosure) as noted above with respect to decision T 793/93.

2.1.3 The subject-matter of claim 1 of the main request is therefore novel.

2.2 Inventive step

As explained in its first paragraph, the patent is directed to the provision of a polyethylene composition and the use thereof in the production of pipes and to pipes, particularly pressure pipes, made from the composition. The pipes are used for transport of liquid and gaseous materials (paragraph [0002]). Specifically the problem addressed is to provide a polyethylene composition for the manufacture of pressure pipes which composition has both good processability, is sufficiently flexible for easy handling and complies with pressure class PE63 (paragraph [0009]).

2.2.1 Closest prior art

D5 is directed to the provision of a polyethylene composition suitable for the production of gas pipes, landfill belts and sheets (column 1 lines 6-9). The resulting pipes are stated to have excellent characteristics (paragraph bridging columns 3 and 4) in terms of processing and mechanical properties (Young's modulus, impact strength, long term stress rupture and long service life).

According to claim 1 this is achieved by a composition having:

- a density of 0.930-0.940g/cm^3
- a MFI (MFR)190/2.16 of 0.05 to 1.0 g/10 minutes
- 50-80 wt% HDPE of MFI 190/2.16 of 0.01 to 0.5 g/10 min
- 20-50 wt% of linear polyethylene of low density and MFI 190/2.16 of 0.5 to 2.0g/10 min.

Regarding the argument of the appellant as to the non-relevance of D5 since the application envisioned therein does not require flexibility (see section XI. (c), above) the Board observes that D5 aims at broadly the same field of application as the patent meaning that fundamentally different pipe properties are not inherent to the two sets of end uses. In particular it is noted that both the patent (paragraph [0002]) and D5 (column 1, line 8) envisage gas pipes. Accordingly there are no grounds for disregarding D5 in the assessment of inventive step.

D7 is directed to the provision of a multimodal polyethylene to prepare shaped articles, in particular pipes for water or gas distribution (page 1, top to page 2, line 6). The problem addressed is to provide polyethylene materials which provide a combination of advantageous thermal, mechanical and processing properties, with the emphasis on high temperature resistance, high stress resistance, good mechanical properties (tensile, impact) and excellent processability (page 2, lines 18-24).

According to claim 1 of D7 this problem is solved by a multimodal polyethylene having:

- a density of 0.925 to 0.950 g/cm^3
- a Melt Index (MFR) 190°C/2.16 Kg of 0.05 to 5 g/ 10 mins
- HMW ethylene interpolymer
- LMW ethylene polymer.

Both of D5 and D7 address therefore the same problem as the patent in suit and hence are equally suitable to serve as closest prior art.

2.2.2 Analysis starting from D5

(a) Distinguishing feature

As noted above with respect to novelty (section 2.1.1) the subject-matter of operative claim 1 differs from the examples in D5 in that it has not been established that the flexural modulus necessarily falls within the range specified in the claim.

(b) Technical effect

The patent contains an example and a comparative example, which are presented in Table 1 of the patent:

	units	**Example 1**	**Comparative Example 1**
PREPOLYMERISATION REACTOR			
Temperature	°C	60	50
Pressure	bar	61	64.2
Split	wt-%	0	2
LOOP REACTOR			
Temperature	°C	85	95
Pressure	bar	58	64
C_2 concentration	mol%	5.7	3.5
H_2/C_2 ratio	mol/kmol	0.46	950
C_4/C_2 ratio	mol/kmol	92	0
Split	wt-%	51	44
MFR_2	g/(10min)	110	325
Density	kg/m^3	939	972
Comonomer		butene-1	
GAS PHASE REACTOR			
Temperature	°C	80	85
Pressure	bar	20	19.5
H2/C2 ratio	mol/kmol	0	50
C4/C2 ratio	mol/kmol	-	200
C6/C2 ratio	mol/kmol	4	-
Split	wt-%	49	54

GAS PHASE REACTOR			
Comonomer		Hexene-1	Butene-1
Density - base resin	kg/m^3	936	940
COMPOUNDING	EXTRUDER	JSW CIM90P	JSWCIM460P
Feed	kg/hr	217	
SEI	kWh/t	277	235
Melt temperature	°C	222	285
PROPERTIES OF COMPOUNDED RESIN/PRODUCED PIPE			
Hexene-1 content	wt-%	1.3	0
Butene-1 content	wt-%	1.6	2.9
MFR2	g/(10 min)	0.45	
MFR5	g/(10 min)	1.4	0.85
MFR21	g/(10 min)		19
M_w	g/mol	157,000	240,000
M_n	g/mol	17,200	8,600
MWD		9.1	28
Density - compound	kg/m^3	937.2	951
$SHI_{(2.7/210)}$		8.6	29.4
$SHI_{(5/300)}$		15.2	52.5
$Eta_{0.05}$	Pa s	23450	52400
E-modulus	MPa	640	
Flexural Modulus	MPa	596	845
Impact strength at 0°C	kJ/m^2	10	16
Impact strength at -20°C	kJ/m^2	5.9	
Pressure test on un-notched 32 mm pipes			
10.0 MPa at 20°C	h		>4719
12.0 MPa at 20°C	h	4144	
4.6 MPa at 80 °C	h		6321
5.1 MPa at 80 °C	h		2
5.4 MPa at 80 °C	h	6259	
Pressure test on notched 110 mm pipes			
4.0 MPa at 80 °C	h		>5000
4.45 MPa at 80 °C	h	2731	
RCP-resistance, $T_{critical}$	°C	+ 1	-4

The following is noted. In the comparative example

the LMW fraction is a homopolymer, whereas the claim requires a copolymer. Moreover, the example and comparative example further differ from each other in a plethora of other features. For example in the copolymer component (prepared in the gas phase reactor) different monomers are used, the splits are different as are the conditions in the second reactor.

Accordingly the example and comparative example are not suitable to show any technical effect arising from a specific feature, nor in particular an effect with respect to the compositions of D5.

(c) Objective technical problem - its solution

On this basis the only technical problem which can be formulated is the provision of further polyethylene compositions with satisfactory mechanical properties.

This problem was solved by undertaking - in the light of the available evidence - arbitrary modifications to the compositions explicitly known from D5.

(d) Obviousness

Such arbitrary modifications are within the ordinary and routine activities of the skilled person when seeking to solve the problem of providing a composition which is merely in some unspecified manner different from those which are known. Further it has not been made credible that there were any particular technical hurdles or obstacles to undertaking the so defined

modifications. In this respect while the information available (in particular the data in D30) were not sufficient to conclude that the examples in D5 necessarily had a flexural modulus within the range of claim 1, they equally show that values within the range are normal when working according to the teaching of D5.

In conclusion the subject-matter of claim 1 is obvious in the light of the teachings of D5.

2.2.3 Analysis starting from D7 as closest prior art

The analysis and conclusion are similar.

As noted, the subject-matter of operative claim 1 differs from that of the examples of D7 - marginally - by the density (940 kg/m^3 vs below 940 kg/m^3) and the absence of a disclosure of the flexural modulus.

However due to the absence of any evidence the formulation of the problem remains the same as for the situation with respect to D5, and the solution - arbitrary modification - is similarly obvious.

In this respect D7 itself discloses a density range between 925 and 950 kg/m^3 and the same considerations as above are valid for the flexural modulus.

2.3 In the light of these negative findings with respect to inventive step it is not necessary for the Board to address any other objection.

3. Auxiliary requests 1 and 1a

As noted above, claim 1 of these requests differs from claim 1 of the main request by

- the density of fraction A was specified - 925 to 945 kg/m^3
- MFR_2 of the base resin was 0.10 to 0.50g/10 min
- shear thinning index SHI2.7/210 was specified as below 20
- flexural modulus was 450 to 650 MPa.

However as for the main request, there is no evidence for any technical effect arising from any of these (further) features which also appear to be within the general disclosure of D5 and D7.

Regarding the specification of the SHI, it has not been shown that this imposes any technical difference on the compositions compared to those of the prior art since this feature is not reported in the documents and apparently has been used only by the patent proprietor. Although in D11 and D11a - the (attempted) replication of D7 - values for SHI are reported, due to the uncertainty concerning the disclosure of D7 (see discussion of novelty in section 2.1.2, above), no weight can be attached to these data.

In any case the absence of any specification of SHI in the prior art does not serve as evidence that the definition of an additional (unusual) parameter imbues the claimed subject-matter with a different technical character, and the contrary has not been demonstrated.

Consequently the amendments made to auxiliary requests 1 and 1a do not give cause to reach a different conclusion with respect to inventive step to that for the main request.

4. Auxiliary requests 2 and 2a

As observed above, claim 1 of these differs from claim 1 of auxiliary request 1 in that:

- the density of fraction A was defined as 925 to 940 kg/m3
- it was required that fractions (A) and (B) were polymerised using the same single-site catalyst
- the density of the base resin was from 920 to below 939 kg/m^3
- the SHI was below 10.

As for the previous two requests considered, there is no evidence for any technical effect associated with these (further) restrictions which remain within the general disclosure of D5 and D7. As to the specification of the catalyst, no further difference can be acknowledged in line with the above analysis developed for novelty (see section 2.1.1(a)). Accordingly there are no grounds for reaching a different conclusion with respect to inventive step.

5. Auxiliary requests 3 and 3a

The following further restriction compared to auxiliary request 2 was made:

- The MFR_2 (190°C/2.16 kg) of fraction A was specified to be between 50 to 140 g/10 min.

Similarly to the situation with the previous requests there are no data to demonstrate the existence of a technical effect associated with this further difference, which remains within the general disclosure

of D5 and D7, leading to the same conclusion of lack of inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Lichtenvort D. Semino

Decision electronically authenticated