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**DECISION**  
of 12 May 2004

**Case Number:** T 0778/99 - 3.3.7  
**Application Number:** 94915636.8  
**Publication Number:** 0668941  
**IPC:** D01F 2/00  
**Language of the proceedings:** EN

**Title of invention:**  
Transport of solutions of cellulose through pipes

**Patentee:**  
Acordis Fibres (Holdings) Limited

**Opponent:**  
Zimmer Aktiengesellschaft / ALCERU Schwarza GmbH /  
Thür.Inst.f.Textil-u. Kunstst.forschung e.V.

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56, 83, 84, 123  
EPC R. 57a

**Keyword:**  
"Amendments - allowable (yes)"  
"Disclosure - sufficiency (yes)"  
"Novelty - (no) main request - (yes) first and second  
auxiliary requests"  
"Inventive step - obvious solution (yes) (first auxiliary  
request)"  
"Inventive step - (yes) (second auxiliary request)"

**Decisions cited:**  
T 0939/92

**Catchword:**  
-



Case Number: T 0778/99 - 3.3.7

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.7  
of 12 May 2004

**Appellants:**  
(Opponents)

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**Decision under appeal:**

Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
4 June 1999 concerning maintenance of European  
patent No. 0668941 in amended form.

**Composition of the Board:**

**Chairman:** R. E. Teschemacher  
**Members:** G. Santavicca  
B. L. Ter Laan

## Summary of Facts and Submissions

- I. The mention of the grant of European patent 0 668 941, in respect of European patent application 94 915 636.8, filed on 20 May 1994 and claiming a right of priority in the USA of 28 May 1993 (US 69184), was published on 17 July 1996. The patent as granted comprised 22 claims, independent Claims 1 and 2 reading as follows:

"1. A method for transporting a flowable solution of cellulose in aqueous N-methylmorpholine N-oxide through a pipe, the temperature in degrees Centigrade of said solution in the centre of said pipe being controlled at

$$1000/(X + 0.19x\sqrt{D})$$

where D represents the internal diameter of said pipe in millimetres and X represents a value equal to or greater than 5.0."

"2. A method for transporting a flowable solution of cellulose in aqueous N-methylmorpholine N-oxide through a pipe, the temperature in degrees Centigrade of said solution at the interior wall of said pipe being controlled at

$$1000/(Y + 0.23x\sqrt{D})$$

where D represents the internal diameter of said pipe in millimetres and Y represents a value equal to or greater than 5.4."

- II. Two notices of opposition were filed on 4 April 1997 and 17 April 1997, respectively, in which revocation of the patent was requested on the grounds of Article 100, paragraphs (a) and (b), EPC, that the claimed subject-matter lacked novelty and inventive step and that the patent did not disclose the invention in a manner

sufficiently clear and complete for it to be carried out by a person skilled in the art. The following documents were cited *inter alia* during the proceedings:

Z1: US-A-4 416 698;

Z5: F.A. Buijtenhuijs et al, "The Degradation and Stabilization of Cellulose Dissolved in N-Methylmorpholine-N-Oxide (NMMO), *Das Papier*, Vo. 40, No. 12, 1986, pages 615-619 (Z5 = L3).

Z7: Brochure "Continuous Mixer and Continuous Extruder", by Groupe Aoustin, F-92400 Courbevoie;

L6: US-A-4 426 228;

L9: EP-A-0 626 198;

L10: E. Henglein, *Lexikon Chemische Technik*, Parat, VCH, 1988, page 50 « Begleitheizung ».

By letter dated 9 January 1998, opponents 02 withdrew their opposition; by a communication dated 20 January 1998, opponents 02 were informed that they no longer were a party to the opposition proceedings.

III. In a decision notified in writing on 4 June 1999, the Opposition Division found that the patent could be maintained in amended form. That decision was based on a set of amended Claims 1 to 21 submitted during the oral proceedings before the Opposition Division as the main request. Independent Claims 1 and 2 were amended to the effect that the pipe was defined to have a

nominal external diameter in the range from 25 to 300 mm.

In its decision, the Opposition Division held that:

- (a) The public availability of Z7 before the priority date of the patent had not been established.
- (b) The amended claims fulfilled the requirements of Article 123, paragraphs 2 and 3, EPC.
- (c) It had not been shown that the claimed methods could not be carried out. Therefore, they were sufficiently disclosed.
- (d) The claimed methods were novel having regard to the methods disclosed in Z1 and L9.
- (e) As to inventive step, Z1 was the closest prior art document. The problem to be solved was the transportation of cellulose solutions in aqueous N-methylmorpholine N-oxide (NMMO) in commercial-scale plants at as high a temperature as possible to reduce the pumping costs, while at the same time avoiding the risk of thermal runaway reactions. According to the patent, that problem was solved by the control features defined in Claims 1 and 2. The prior art did not suggest any control means at or in a pipe in which a flowable solution of cellulose in aqueous NMMO was transported, in order to keep the temperature of the solution within the ranges of Claims 1 and 2.
- (f) Therefore, the amended patent fulfilled the requirements of the EPC.

- IV. On 2 August 1999, the opponents (appellants) lodged an appeal against that decision; the fee for appeal was paid on 3 August 1999; the statement setting out the grounds of appeal was received on 4 October 1999; further arguments were given in two letters dated 2 October 2000 and 12 September 2003, respectively.
- V. In a letter dated 27 April 2000, the proprietors (respondents) enclosed three sets of amended claims as first to third auxiliary requests.
- VI. At the beginning of the oral proceedings held on 24 September 2003, the respondents requested a postponement on the grounds that on the day before a major accident had occurred in the Lenzing Lyocell Staple Fibre Plant in Heiligenkreuz (AT) of which the consequences for the validity of the patent were not clear. The appellants did not object to a postponement. Therefore, the substance of the case was not discussed and a new date was agreed. For the further proceedings, the Board drew attention to T 939/92 (OJ EPO 1996, 309).
- VII. In a letter dated 8 April 2004, the respondents enclosed a set of amended claims as the fourth auxiliary request and submitted a letter from Lenzing AG, in which it was stated that the accident was not caused by and did not involve an exotherm within a pipe used to transport the solution of cellulose in an aqueous NMMO around the production plant.
- VIII. Oral proceedings were held on 12 May 2004. The respondents filed a set of amended claims replacing the first auxiliary request submitted with letter dated

27 April 2000, which was withdrawn. The new first auxiliary request comprises 19 claims. Independent Claims 1 and 2 read as follows, respectively:

"1. A method for transporting a flowable solution of cellulose in aqueous N-methylmorpholine N-oxide through a pipe of nominal external diameter in the range from 25 to 300mm, said pipe being equipped with a thermostatic jacket, the temperature in degrees Centigrade of said solution in the centre of said pipe being controlled by said thermostatic jacket at

$$1000/(X + 0.19x\sqrt{D})$$

where D represents the internal diameter of said pipe in millimetres and X represents a value equal to or greater than 5.0."

"2. A method for transporting a flowable solution of cellulose in aqueous N-methylmorpholine N-oxide through a pipe of nominal external diameter in the range from 25 to 300mm, said pipe being equipped with a thermostatic jacket, the temperature in degrees Centigrade of said solution at the interior wall of said pipe being controlled by said thermostatic jacket at

$$1000/(Y + 0.23x\sqrt{D})$$

where D represents the internal diameter of said pipe in millimetres and Y represents a value equal to or greater than 5.4."

Claims 1 and 2 according to the second auxiliary request filed with letter dated 27 April 2000 are further limited by the addition, at the end of the claims, of the following feature: "and the temperature

of said solution in the centre of said pipe being at least 100°C".

Claims 1 and 2 according to the third auxiliary request filed with letter dated 27 April 2000, compared to Claims 1 and 2 of the second auxiliary request, are further limited in that the temperature of the thermostatic jacket is maintained below the temperature of the solution in the centre of the pipe.

Claims 1 and 2 according to the fourth auxiliary request filed with letter dated 8 April 2004, compared to Claims 1 and 2 according to the main request underlying the decision under appeal, have been restricted to a method of manufacturing a shaped cellulosic product, in order to cover the transportation of a flowable solution of cellulose in aqueous NMMO through pipes only in the context of that method.

IX. The appellants argued essentially as follows:

- (a) From the definitions in Claims 1 and 2, in particular those according to the main and the first auxiliary requests, it was apparent that:
  - (i) The control feature did not define a "shall" temperature and means for adjusting any "actual" value to that temperature. Hence, no closed-loop control was defined;
  - (ii) only the lower values of variables "X" and "Y" were given, which permitted the calculation of an upper temperature for the



solution. However, any higher values for "X" and "Y" were possible. Therefore, the solution could be transported at any temperature below that upper temperature at which it was flowable;

(iii) the minimum temperature for a flowable cellulose solution was not given;

(iv) reference was made to internal and nominal external diameters of the pipe, but no relation between them was given. Thus, pipes with small internal diameters were envisaged by the claims.

(b) As regards sufficiency of the disclosure, "X" and "Y" could assume any values equal to or above the minima defined in Claims 1 and 2. The use of a pipe with a small nominal external diameter for transporting the cellulose solution was within the ambit of Claims 1 and 2, which did not define any relationship between the nominal external and the internal diameters of the pipe. Since the pipe was suitable for high pressure, requiring a thick wall, it could have a very small internal diameter. According to the algorithms of Claims 1 and 2, a cellulose solution in aqueous NMMO could be transported within such a small pipe at a temperature higher than 170°C. However, according to the patent in suit, at such temperatures the solution would be subject to an uncontrolled exothermic reaction. Since the patent in suit did not disclose which values of "X" and "Y" enabled the transport of the cellulose solution and which

did not, and the claims encompassed conditions at which the transported solution was at risk of an exotherm, the claimed methods could not be carried out safely under all the conditions envisaged by the claims.

*Main request*

- (c) L9 disclosed the transport of a cellulose solution in aqueous NMMO within the heated entry lines of an emergency dump tank, after controlled venting of that solution following the occurrence of an exothermic reaction. That dump tank was located within a commercial plant, the pipes of which had the dimensions as now being claimed. The temperatures mentioned in L9 corresponded to values for "X" and "Y" which were within the ranges as claimed. L9 also disclosed that in the rest of the plant the cellulose solution would be piped at a temperature of 100 to 115°C, which implied a control of the temperature such that it did not exceed those values. Therefore, L9 was novelty destroying.

*First auxiliary request*

- (d) The additional apparatus feature in the definitions in Claims 1 and 2, i.e. a thermostatic jacket to maintain the temperature, did not change the fact that the control merely resided in not exceeding a maximum temperature. L9 disclosed that the wall of the entry lines to the dump tank were maintained at about 100°C, which conditions were encompassed by the claimed methods. Further, Example 1 of Z1

disclosed the transport of a cellulose solution in aqueous NMMO through a two-inch Teledyne Readco continuous processor at 103 to 106°C. That processor was provided with a temperature controlling jacket, as mentioned in Z7, a brochure showing the features of the processor. Therefore, the claimed subject-matter lacked novelty over the disclosure of either of L9 or Z1.

- (e) As regards inventive step, the closest prior art document was Z1. The problem to be solved, according to the patent in suit, was a reduction of the pumping costs while preventing the occurrence of an uncontrolled exothermic reaction within the solution. However, in the claimed methods, the lower temperature for the solution to be transported was only limited by the requirement that it should be "flowable". Since the viscosity decreased with the temperature, the transport of very viscous solutions was envisaged by Claims 1 and 2. It had not been shown, however, that at such low temperatures a reduction of the pumping costs was achieved. Also, since the internal diameter of the pipe could be very small, under some of the conditions envisaged by the claims, the solution would in fact be at risk of an exothermic reaction. Therefore, the problem stated in the patent in suit had not been solved within the whole ambit of the claims. The skilled person knew the thermal behaviour of a cellulose solution in aqueous NMMO, e.g. from Z5, in particular that the cellulose solution, depending on the content of particular additives, was relatively stable up to certain low temperatures and was at risk of an exotherm only

above those temperatures. As the application of known low temperature conditions for the safe transport of a cellulose solution within an industrial plant and the use of standard equipment such as a thermostatic jacket to maintain the solution at such temperatures were within the capabilities of the skilled person, the claimed methods were obvious.

*Second auxiliary request*

- (f) The novelty of the methods according to any of Claims 1 and 2 was not contested.
  
- (g) As regards inventive step, the additionally required minimum temperature for the transport was sufficiently high to permit a reduction of the pumping costs. However, it had not been shown that the means set out in the claimed methods were sufficient to avoid the occurrence of an uncontrolled exothermic reaction under all the conditions envisaged by the claims. Therefore, the problem as defined had not been solved. Since the solution defined in the claims was a collection of obvious measures, the claimed subject-matter did not involve an inventive step.

X. The respondents argued essentially as follows:

- (a) The patent in suit concerned the prevention of uncontrolled exothermic reactions which could occur during the transportation of cellulose solutions in aqueous NMMO in the pipelines of commercial installations. The risk of the occurrence of such reactions was present, in principle, at any

temperature at which the solution was transported. The cause of an uncontrolled exothermic reaction was a spontaneous deterioration of the solution, accompanied by a rapid generation of gas, leading to controlled or uncontrolled venting. Uncontrolled venting could give rise to a gas explosion. The accident which occurred in the plant of Lenzing had not been due to an exothermic reaction in a pipe. The damage was such that the plant had been out of production for three months, with a loss of millions of Euros. The same kind of damage could be caused by exothermic reactions, which illustrated the importance of preventing the occurrence of such reactions. Pumping costs reduction was not the primary concern.

- (b) As regards sufficiency of the disclosure, the algorithms in the claims had been established so as to give the methods a sufficient level of safety. The transport of a cellulose solution within a pipe had been tested by the respondents under the practical conditions of commercial installations. The skilled person reading the patent in suit could carry out the transport within the conditions envisaged by the claims, at which temperatures the solution could be safely transported. Therefore, the disclosure was sufficient.

*Main request*

- (c) L9 was a document pursuant to Article 54(3)(4) EPC, which originated from the proprietors of the patent in suit. The material flowing from the pipeline to the dump tank was not to be processed to

manufacture a product but contained a degraded solution to be discarded. Since that material was congealable, the entry lines of the dump tank were heated. Hence, any positive control of temperature during the transport was absent, instead the degraded solution would be at a high, uncontrolled temperature. Therefore, no transport as claimed was carried out in the entry lines of the dump of L9. As regards the rest of the plant, L9 disclosed that the solution would be piped at a temperature between 100 and 115°C, i.e. would be left to flow at any such temperature without any positive control of the temperature as in the patent in suit. Therefore, the claimed methods were novel.

*First auxiliary request*

- (d) L9 did not disclose the transport of a cellulose solution under the conditions required by the claims, nor the presence of a thermostatic jacket on the entry lines to the dump tank. Therefore, L9 was not novelty destroying.

The processor mentioned in Z1 was not a pipe in the sense of the patent in suit, in which a ready cellulose solution was transported from the entrance to the exit, but rather a piece of equipment in which the solution was formed under vacuum, by degassing and removing micro-bubbles. Although Z7, a technical brochure that concerned that processor, disclosed further particulars, the public availability of Z7 before the priority date of the patent in suit had not been proven. Furthermore, Z1 did not disclose that the

processor used in its Example 1 had a thermostatic jacket as mentioned in Z7. Therefore, whatever the public status of Z7, Z1 was not novelty destroying.

- (e) As to inventive step, Z1 concerned laboratory scale spinning, not industrial scale. The processor used was not a pipe in the sense of the patent in suit. No recommendation whatsoever could be found in Z1 for carrying out safely the transport of a cellulose solution within the pipelines of a commercial plant. Thus, Z1 was not the closest prior art document. L6, acknowledged in the patent in suit, was closer than Z1. The problem underlying the patent in suit was to avoid exothermic reactions at essentially any temperature during the transport of a cellulose solution in a pipe within a commercial installation. The risk of the occurrence of an exothermic reaction increased with the temperature. That problem did not occur at laboratory scale where the processing time was kept very short. The avoidance of a runaway reaction at any temperature was achieved by the means set out in the present claims, such as a positive control of the temperature of the material flowing through the pipe by a thermostatic jacket, which effectively prevented the degradation of cellulose under those circumstances. Nothing of this was suggested in Z1 or L6. The further documents cited, such as Z5, taught that it was known that the cellulose solution in aqueous NMMO was thermally unstable and subject to discolouration, without giving a teaching or a clear indication of how to use this information in an industrial process,

however. Therefore, the claimed subject-matter was not obvious.

*Second auxiliary request*

- (f) As regards novelty, the same arguments as for the first auxiliary request applied.
  
- (g) As to inventive step, the required minimum temperature of at least 100°C at which the cellulose solution should be transported, permitted to obtain a reduction of the pumping costs. That reduction was attainable at high temperatures, where the risk of an exotherm was high. The thermostatic jacket controlled the temperature at the centre or at the wall of the pipe, as desired between the minimum of 100°C and the maximum derivable from the algorithms, which could be higher than 120°C as mentioned in e.g. Z5, while preventing the occurrence of runaway reactions. This had been demonstrated by the industrial plants successfully running according to the claimed methods. Therefore, the problem underlying the patent had been effectively solved. The cited documents did not deal with industrial scale plants nor did they suggest how to operate in order to transport safely a solution of cellulose in aqueous NMMO while reducing the pumping costs. Therefore, the claimed methods were not obvious.

XI. The appellants (opponents) requested that the impugned decision be set aside and that the patent be revoked.



The respondents (proprietors) requested that the appeal be dismissed and that the patent be maintained on the basis of the main request underlying the decision under appeal, or, alternatively, on the basis of one of the following auxiliary requests:

- first auxiliary request as submitted during the oral proceedings;
- second and third auxiliary requests filed with letter dated 27 April 2000;
- fourth auxiliary request filed with letter dated 8 April 2004.

### **Reasons for the Decision**

1. The appeal is admissible.

#### **Main request**

2. *Amendments*

- 2.1 Compared to Claim 1 as granted, Claim 1 according to the main request contains the added feature: "of nominal external diameter in the range from 25 to 300mm" (line 3, after "pipe"). That amendment is also present in Claim 2.

- 2.2 The additional feature has a basis in Claim 11 as originally filed as well as in the original description (page 5, lines 20 to 23). The amendment restricts the protection conferred by Claims 1 and 2 as granted.

2.3 Claims 11 to 21 also contain amendments, which, however, merely aim at adapting the numbering of the claims and their references to the previous claims, as a consequence of the incorporation of Claim 11 as granted in Claims 1 and 2.

2.4 The amendments do not introduce any ambiguities into the claims (Article 84 EPC) and serve the purpose of defining the industrial scale of the method, which is occasioned by the grounds of opposition (Rule 57a EPC).

2.5 Since the patent in suit has not been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC), and Claims 1 and 2 have not been amended in such a way as to extend the protection conferred (Article 123(3) EPC), the main request is admissible.

### 3. *Sufficiency of the disclosure*

3.1 An invention is sufficiently disclosed within the meaning of Article 83 EPC if a person skilled in the art can carry it out on the basis of the information provided in the patent specification as filed, in the light of common general knowledge.

3.2 The appellants did not contest that the invention could be carried out under conditions such as those exemplified in Table 1 of the patent in suit. The objection rather referred to the fact that temperatures at which the transported solution of cellulose was at

risk of a runaway reaction were encompassed by the claims.

3.3 However, the following should be noted:

- (a) The definitions of Claims 1 and 2 do not contain any results to be achieved, let alone any quantification of the safety of the transport in terms of a reduction of the risk of the occurrence of an exotherm during the transport of the solution;
- (b) such results are mentioned in connection with the definition of the problem underlying the patent in suit (column 2, lines 24 to 48) and of the effectiveness of the solution to that problem (column 5, lines 42 to 45);
- (c) the question as to whether or not an alleged technical effect that is not part of the definition of the claimed activities but rather underlies the problem to be solved, is obtained in all the situations covered by the claims may properly arise under Article 56 EPC, not under Article 83 EPC (T 939/92, *supra*, Reasons, points 2.4 to 2.6).

3.4 The argument that the claims encompass embodiments which do not lead to the desired result, i.e. conditions at which the transported solution is at risk of a runaway reaction, is therefore not relevant for the requirement of sufficient disclosure.

3.5 Since the appellants have not brought forward any other arguments, the Board arrives at the conclusion that the grounds of opposition under Article 100(b) EPC do not prejudice the maintenance of the patent.

4. *Novelty*

4.1 From the definitions in Claims 1 and 2 it is apparent that:

- (a) The transported material is broadly defined as "a cellulose solution in aqueous NMMO", which is not necessarily a dope for the manufacture of a lyocell article. Thus, the transport of any cellulose solutions in aqueous NMMO is envisaged by Claims 1 and 2.
- (b) The length of the pipe and the flux of the solution in the pipe are not defined. Consequently, the transport of any volume of the solution within the pipe, for any unit of time, is encompassed by Claims 1 and 2.
- (c) The way of carrying out the control of the temperature at the given locations is not defined in Claims 1 and 2. Thus, any control, e.g. direct, indirect, positive, closed-loop, etc., is envisaged by the definitions in Claims 1 and 2. Furthermore, since X and Y may have any value above their minimum, the definition of the control in Claims 1 and 2 merely amounts to the requirement to not exceed the maximum temperature calculated from the algorithm for any given pipe size. The distance in real temperature from that

maximum temperature represents the safety margin. This interpretation is in line with the one expressed by the proprietors in their response to the oppositions (letter dated 18 November 1997, point 7.3, last paragraph, last sentence: "Claims 1 and 2 do not require temperatures to be set and controlled at precise values. They define a much simpler solution: do not exceed the specified temperatures.").

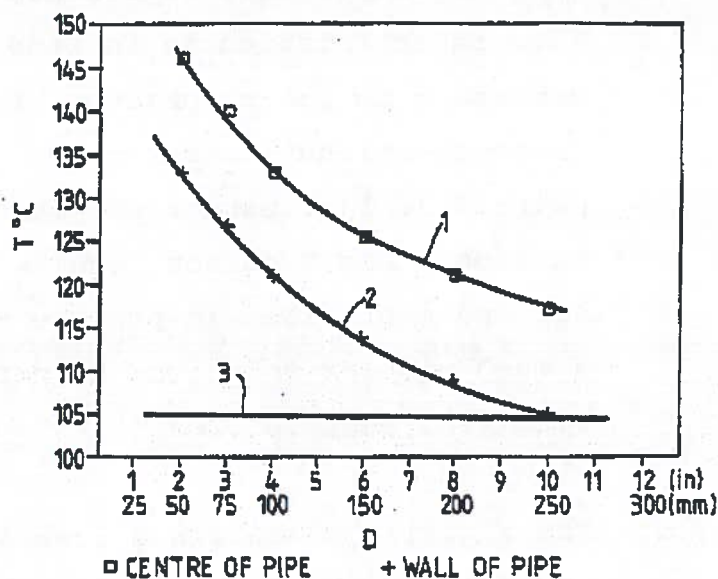
- (d) The algorithms contain a fraction in which variables X, Y and D are part of the denominator. An increase of the values of X, Y or D leads to lower values for the temperature. In particular, for any given pipe size, the lowest value of X (i.e. 5) or Y (i.e. 5.4) determines the maximum temperature that should not be exceeded by the solution to be transported, in the centre or at the interior wall of the pipe, respectively. The algorithms in the claims can thus be rewritten as:

$$T \leq 1000 / (5 + 0.19x\sqrt{D}) \quad (\text{Claim 1}),$$

$$T \leq 1000 / (5.4 + 0.23x\sqrt{D}) \quad (\text{Claim 2}).$$

From the rewritten algorithms, it is apparent that the maximum temperature, which should not be exceeded, is only a function of the pipe size, D.

The rewritten algorithms, where "X" and "Y" have their minimum values, represent mathematical correlations between T and D. Graphically, they take the form of curves 1 and 2 as in Figure 2 in the patent in suit:



The points on the curves have, however, been calculated for X=5.5 and Y=5.9. Hence, if X and Y have their minimum values, 5 and 5.4, respectively, the curves are shifted to a higher position. Any points within the area below the curves represent suitable conditions for carrying out the claimed methods, provided that the solution remains flowable. As a case in point, for a pipe with an internal diameter of 8 inches (about 200 mm) the temperatures that should not be exceeded are 121°C at the centre of the pipe and 109°C at the wall thereof. For a pipe with an internal diameter of 10 inches (about 250 mm) these temperatures are 117° and 105°C, respectively.

- (e) Apart from the requirement that the cellulose solution should remain flowable, Claims 1 and 2 do not define any minimum temperature. Hence, the methods can be operated at any conditions between the maximum temperature as calculated for the minimum values for "X" and "Y" by the algorithms

given under point 4.1(d), *supra*, and the minimum temperature at which the cellulose solution is still flowable. Thus, any temperature between the maximum corresponding to the internal diameter of the pipeline and the temperature at which the cellulose solution is still flowable is encompassed by Claims 1 and 2. For the largest claimed diameter, if "X" has the minimum value of 5, the temperature at which the solution is transported should not exceed 121°C at the centre of the pipeline, which value increases with smaller internal diameters. Since "X" can, however, have higher values, the above also applies to other pipe sizes within the definition of Claims 1 and 2. Therefore, a temperature range of e.g. 100°C to 115°C is envisaged by Claims 1 and 2.

4.2 L9, which is relevant only for novelty (Article 54(3) EPC), discloses a process for safely venting a solution of cellulose in an aqueous N-methyl morpholine N-oxide solvent from a pipeline following an exotherm of said solution. That process includes the steps of:

- (i) transporting said solution via a dump line to a dump tank defining a chamber,
- (ii) said chamber communicating with an entry port for said dump line, a vapour exit port communicating to atmosphere and at least two access ports having openable access doors,
- (iii) permitting at least partial cooling and congealing of said solution in said chamber,

- (iv) opening both of said access doors to permit access to said chamber, and
- (v) pushing said at least partially congealable solution out of the chamber via one of said access ports by pushing on said at least partially congealable solution from the other of said access ports (Claim 4).

The dump tank for the reception of a congealable material vented from a chemical process defines a chamber communicating with at least one entry line for the entry of congealable material into said chamber and a pair of access ports openable in said tank to permit removal of congealable material from said chamber by opening both of said access ports and pushing congealable material from one of said ports out of the chamber (17) through the other of said ports (Claim 1).

- 4.2.1 The exotherm mentioned in L9 is an uncontrollable chemical reaction, a runaway reaction, characterised by the release of excessive quantities of thermal energy in a very short period of time. The cause of that reaction lies in the degradation of the cellulose solution, which is accompanied by the emission of heat. This emission can get out of control, or cause an exotherm, once the temperature of the solution reaches about 170°C, or about 180°C if appropriate stabilisers such as propyl gallate are used (column 1, lines 29 to 45). However, even when the solution experiences a higher temperature below the above levels, e.g. 135°C, for a sufficiently long time, e.g. one hour, an exotherm can also occur (column 3, lines 36 to 40). According to L9, the degradation of the cellulose



solution in NMMO is therefore temperature as well as time dependent.

- 4.2.2 L9 concerns a method and an apparatus for safely relieving, in the event of an exotherm, pressure and material from a pipeline in which a solution of cellulose in NMMO is pumped. The material relieved is congealable, i.e. it considerably increases its viscosity on cooling (column 1, lines 46 to 58). Since the expelled material can congeal and block the lines, the entry lines are heated to 90 to 120°C, preferably 100 to 115°C (column 3, lines 41 to 51).
- 4.2.3 The vent tank of L9 is located within a chemical plant, such that its entry lines are in communication with any source of congealable material that may be required to be forced, in an emergency, into the tank. According to L9, a "typical chemical plant" is one handling a solution of cellulose in an aqueous NMMO solvent, whereby the solution would be piped in the pipelines at about 100°C to 115°C (column 3, lines 33 to 36).
- 4.2.4 As pointed out above (point 4.1(e), *supra*), a temperature range of 100 to 115°C is encompassed by present Claims 1 and 2. Therefore, L9 directly and unambiguously discloses a transport of a cellulose solution in aqueous NMMO under temperature conditions which fall under the terms of present Claims 1 and 2.
- 4.2.5 The fact that in L9 a temperature of 115°C would not be exceeded when piping the cellulose solution corresponds to the meaning of the "control feature" in Claims 1 and 2 in suit (point 4.1.(c), *supra*). In this respect, the respondents have not shown that in the typical

chemical plant of L9 the condition "would be piped in pipelines at about 100 to 115°C" can be achieved without any control of the temperature.

4.2.6 The size of the pipelines is not explicitly mentioned in L9. It was however not contested that typical chemical plants employ pipes having a nominal diameter as defined in Claims 1 and 2 of the patent in suit. In fact, the nominal diameter range in Claims 1 and 2 was added to make it clear that the claimed subject-matter concerns an industrial-scale transport, as is the case in L9. That addition was not meant as a distinctive feature over L9 (Response to the Oppositions, letter dated 18 November 1997, point 2.1; letter dated 19 March 1999, point D.3). The "typical chemical plant" in L9 encompasses lyocell-fibre plants (column 1, lines 22 to 26). Hence, the nominal diameter defined in Claims 1 and 2 cannot confer novelty over L9.

4.3 Therefore, L9 discloses a method for transporting a flowable solution of cellulose in aqueous N-methylmorpholine N-oxide through the pipelines in a typical chemical plant, the nominal diameter of which is in the range of 25 to 300 mm, under a range of the temperature in degrees Centigrade of not lower than 100 and not higher than 115. It follows from the above that the methods of Claims 1 and 2 lack novelty.

4.4 Consequently, the main request is not allowable.

**First auxiliary request**

5. *Amendments*

5.1 Compared to Claim 1 according to the main request, Claim 1 of the first auxiliary request contains the following amendments:

- (a) "said pipe being equipped with a thermostatic jacket" - immediately after "of nominal external diameter in the range from 25 to 300mm,";
- (b) "by said thermostatic jacket" - between "controlled" and "at  $1000/(X+0.19x\sqrt{D})$ ".

Corresponding amendments have also been made to Claim 2.

5.2 The feature "said pipe being equipped with a thermostatic jacket" has a basis in Claim 16 as filed, which is identical to Claim 16 as granted and which was dependent from Claims 1 and 2 as filed. The feature according to which the temperature is controlled "by said thermostatic jacket" has a basis in the application as filed (page 6, lines 1 to 5). These amendments further restrict the protection conferred by Claims 1 and 2 as granted.

5.3 In Claims 11 to 19, the numbering of the claims and their references to the previous claims have been adapted to the deletion of Claims 11, 13 and 16.

5.4 Therefore, the amendments do not introduce any ambiguities in the claims, in particular in Claims 1 and 2 (Article 84 EPC). Also, the amendments are occasioned by the grounds of opposition (Rule 57a EPC).

Furthermore, the patent in suit has not been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC) and Claims 1 and 2 according to the first auxiliary request have not been amended in such a way as to extend the protection conferred (Article 123(3) EPC).

6. *Novelty*

6.1 As described above (point 4.2.2), in the plant of L9, the entry lines to the chamber are heated. The vent line from the chamber is provided with a heater, either electrical or with hot water, to keep its temperature at about 100°C (column 4, lines 3 to 6). Although nothing is said about any heaters on the entry lines, L9 discloses that the temperature of the internal walls of these entry lines is controlled to prevent any material remaining within the pipe from congealing and obstructing the conduits.

However, L9 does not mention the actual temperature of the expelled solution. Since the solution has experienced an exothermic reaction, it is degraded and hot, such that its temperature is likely to be well above 135°C. L9 does not disclose any specific action to control that temperature, let alone by a thermostatic jacket, such that it does not exceed a maximum temperature.

It follows from the above that L9 cannot not be novelty destroying.

6.2 Z1 discloses a shaped cellulose article which has been formed by a process which comprises shaping a solution containing cellulose dissolved in a solvent therefor which contains a tertiary amine N-oxide solvent for cellulose and a nonsolvent for cellulose which is miscible with the tertiary amine N-oxide solvent, stretching the resulting shaped solution and then precipitating the cellulose from said resulting shaped solution to form said shaped cellulose article having improved physical properties (Claim 1).

According to Z1, degradation of the cellulose can be substantially reduced by dissolving it in a tertiary amine N-oxide solvent in the barrel of an extrusion apparatus, extruding the solution to form a shaped solution and promptly precipitating the cellulose from the shaped solution before significant degradation of the cellulose (column 4, lines 49 to 56). The preferred temperature range in the barrel of the extruder for dissolving the cellulose is from about 90°C to about 140°C (column 5, lines 29 to 31).

In particular, the cellulose can be dissolved by first mixing a pulp with tertiary amine N-oxide containing excess nonsolvent, preferably water, in a quantity which prohibits the formation of a solution, then exposing the mixture to conditions of temperature and reduced pressure which result in removal of the excess nonsolvent, thereby allowing solution to take place (column 5, lines 35 to 41). The formed solution can then be transported by means of a pumping device through a shaping die (column 5, lines 47 to 58).

As equipment suitable for removing the excess nonsolvent, the Teledyne Readco continuous processor is used in Example I of Z1. The processor is equipped with screws and helical paddles, to transport the solution through it at 103-106°C under vacuum. Then, a gear pump forces the solution through a spinneret having 32, 250 micrometers diameter holes, at 120-125°C. Therefore, the processor of Z1 serves the purpose of forming a cellulose solution; it does not have the purpose of transporting a ready cellulose solution from one place to another (column 6, lines 30 to 41).

Even if the processor was taken as a pipe because it is a hollow elongated object, Z1 discloses neither a nominal external diameter in the range of 25 to 300 mm nor that the processor is equipped with a thermostatic jacket to control the temperature of the solution. Any reference to Z7 for the possible presence of a temperature-controlling jacket (Z7: third page, "optional equipment") fails, since Z1 does not refer to Z7 and anyway it is not clear that Z7 was publicly available before the priority date of the patent in suit.

As regards any transport which takes place after the processor of Example I of Z1, it would concern a small amount of cellulose solution, which has not been shown to need a pipe size as defined in Claims 1 and 2 (response to the notice of opposition 01 dated 18 November 1997, point 6.2).

It follows from the above that Z1 cannot be novelty destroying either.

6.3 Therefore, the subject-matter of any of Claims 1 and 2 of the first auxiliary request is novel.

7. *Closest prior art*

7.1 The patent in suit concerns the transport of solutions of cellulose through pipes.

7.2 The processing of solutions of cellulose in aqueous tertiary amine N-oxide as well as a method for preparing a shaped article from said solutions is described in both Z1 and L6.

7.3 The method of Z1 (point 6.2, *supra*) aims at making shaped cellulose articles having improved physical properties from cellulose solutions in which a tertiary amine N-oxide is the solvent. The objectives of Z1 are to produce shaped cellulose articles having good mechanical properties, low swelling and only a slight increase in wet elongation over conditioned elongation at low stress. The cellulose should be made from a solution which does not pollute the environment with metal salts, sulphur compounds or ammonia (column 2, line 40 to column 3, line 2). In order to avoid degradation, the cellulose is dissolved in the barrel of an extruder, the solution is extruded, spun and promptly precipitated before significant degradation of the cellulose (column 4, lines 50 to 56). Z1 does not mention any stabilization of the cellulose solution.

7.4 L6 discloses a moulding or spinning substance, comprising, by weight, 4.99-25% cellulose, 95-50% of a tertiary amine oxide, in given instances up to 25% of a non-solvent and up to 10% of other polymers, all

proportions relative to the weight of the moulding or spinning substance, and as additive, singly or in a mixture, 0.01 up to 0.5% by weight, relative to the tertiary amine oxide, of an organic compound with a minimum of four carbon atoms and a minimum of two conjugated double bonds and a minimum of two groups in the form of hydroxyl and/or amino groups which, in turn, have a minimum of one unsubstituted hydrogen atom and/or contain glycerol aldehyde, said additive being soluble in said tertiary amine oxide as well as its mixture with said non-solvent (Claim 1). Preferably, the organic compound is pyrocatechol, pyrogallol, gallic acid, or the methyl ester, ethyl ester, propyl ester or isopropyl ester of gallic acid (Claim 9).

L6 also discloses a process for producing the moulding or spinning substance, comprising stirring the cellulose and, in given instances, also the other polymer, at temperatures between 70 and 190°C, in a tertiary amino oxide containing the organic compound as additive and, in given instances, up to 25% by weight of a non-solvent, said stirring to proceed until the polymer has been dissolved (Claim 11). The temperature is preferably between 100 and 150°C, more preferably between 115 and 130°C (Claims 12 and 13).

The moulding or spinning substance is employed in a process for the production of moulded shapes of the type in which a moulding or spinning substance is extruded through an extruder (Claim 15).

- 7.4.1 According to L6, cellulose present in a solution to be used as spinning dope is subject to decomposition of its polymer chain, which decomposition leads to



undesirable discoloration and impairs the properties of the shaped articles produced therefrom (column 1, lines 7 to 28). Polymer decomposition increases with rising temperatures and longer times and when holding processing temperature and time as low as possible, it remains high (column 1, lines 29 to 41).

7.4.2 Therefore, the object of L6 is to reduce decomposition of the moulding and spinning substances, so that the substances contain only small proportions of decomposition products, in order to produce cellulose articles displaying improved technological properties (column 1, lines 48 to 53).

7.4.3 In order to reduce polymer decomposition, L6 proposes the use of additives for stabilizing the solution, as described above. According to L6, stabilized cellulose solutions can be processed at a higher temperature for longer time than non-stabilized cellulose solutions (column 4, lines 6 to 10). This also applies to viscous solutions containing high concentrations of cellulose and additives in aqueous NMMO solvent (column 7, lines 11 to 18).

7.5 It is apparent from the above that whilst Z1 proposes to reduce the decomposition of cellulose in aqueous NMMO solvent by processing the solution as quickly as possible, L6 addresses the problem of stabilising a solution of cellulose in aqueous NMMO solvent, in order to permit that it can be processed at a higher temperature and longer time without degradation, even when the content of cellulose, and hence the viscosity, is high.

7.5.1 The problem underlying the patent in suit was to provide a method for safe transportation of a flowable solution of cellulose in aqueous NMMO through a pipe in industrial-scale plants at as high a temperature as possible (column 2, lines 20 to 23) whilst preventing the occurrence of an uncontrolled exothermic reaction (column 2, lines 28 to 48; column 5, lines 42 to 45).

7.5.2 Therefore, L6 rather than Z1 is directed to the same purpose and effect as the patent in suit, so that L6 represents the closest prior art for assessing the presence of an inventive step in the claimed subject-matter.

8. *Problem-solution*

8.1 The patent in suit proposes to solve the problem defined above (point 7.5.1) by the solutions as defined in present Claims 1 and 2.

8.2 The conclusions drawn regarding the scope of the claims of the main request (points 4.1(a)-(e), *supra*) are also valid for the first auxiliary request. The methods of Claims 1 and 2 encompass the transport of a cellulose solution in aqueous NMMO having any concentration, hence any viscosity, in an industrial plant, at any low temperature, provided that the solution is flowable. However, the patent in suit does not show that a cellulose solution in an aqueous NMMO solvent can be transported at low pumping costs in industrial-scale plants at any low temperature at which the solution is still flowable. Instead, the patent in suit mentions that the viscosity of a cellulose solution in aqueous NMMO suitable to be spun into lyocell fibres is

sufficiently low for it to be pumped through pipes in a commercial scale factory when it has a temperature of at least 100°C, preferably 105°C (column 4, lines 41 to 46). Since temperatures lower than 100°C inevitably lead to higher viscosity and hence higher pumping costs, it has not been shown that a solution of cellulose in aqueous NMMO can be transported on industrial scale at lower pumping costs than by known methods over the whole scope of Claims 1 and 2.

8.3 It follows from the above that the methods of Claims 1 and 2 do not represent effective solutions to the problem underlying the patent in suit of reducing the pumping costs when the solution is transported within pipelines of an industrial plant.

8.4 Therefore, the problem has to be reformulated on a less ambitious basis as to provide a method for safe transportation of a flowable solution of cellulose in aqueous NMMO through a pipe in industrial-scale plants.

8.4.1 The appellants, before the opposition division as well as during the appeal proceedings, have argued that the thermal instability, under particular conditions, of the cellulose solutions in aqueous NMMO, which instability could lead to runaway reactions, was known to the skilled person, e.g. from Z5 (notice of opposition 01, page 8, first full paragraph; notice of opposition 02, page 5, last full paragraph). They infer from this that in the absence of any experience on industrial plants the skilled person would use that knowledge.

8.4.2 Figure 5 of Z5 shows that, when processing a solution of cellulose in aqueous NMMO under conditions such as temperature higher than 100°C and poor heat transport, it may be expected that the cellulose solution becomes thermally instable, such that the occurrence of a thermal runaway reaction cannot be excluded (page 617, right column, last paragraph; page 618, left column, lines 1 to 6). It is apparent from that disclosure that when processing under temperatures lower than 100°C while ensuring good heat transport the risk of the occurrence of an exothermic reaction is reduced.

8.4.3 L10 (page 50; "Begleitheizung") teaches the use of a thermostatic jacket to control the temperature of a fluid circulating inside a pipeline. According to L10, in installations with risks of explosions, the requirement of not exceeding a maximum temperature is particularly important. Therefore, it is plausible that the use of a thermostatic jacket permits control of the temperature while ensuring a good heat transport, such that the risk of the occurrence of an exothermic reaction is reduced. Nor have the appellants argued or demonstrated that the means defined in Claims 1 and 2 would not be an effective solution to the reformulated problem.

8.4.4 Therefore, the above defined problem is considered to have been effectively solved by the features defined in Claims 1 and 2.

*Obviousness*

9. It remains to be decided whether or not the claimed methods were obvious having regard to the cited prior art.
- 9.1 According to L6, a reduction of the processing temperature reduces the degradation of the cellulose polymer (column 1, lines 29 to 31). Degradation is also reduced by stabilizing the solution with appropriate additives (column 2, lines 15 to 17; column 7, line 19 to column 8, line 4).
- 9.2 From Figure 5 of Z5, in which L6 is acknowledged by mention of its priority document ("references", page 618, DE-A-3 034 685), it is apparent that when processing a cellulose-NMMO-water solution at temperatures below 100°C, while ensuring a good heat transport, it may be expected that the cellulose solution is rather stable, which implies that occurrence of a thermal runaway reaction is reduced. The presence of stabilizers enhances that reduction (page 617, right column, last paragraph; page 618, left column, lines 1 to 6; Table 4).
- 9.3 From L10, the use of a thermostatic jacket for maintaining the temperature was known.
- 9.4 It follows from the above that it was known that lower temperatures reduce the risk of degradation of the cellulose solution, hence of the occurrence of an uncontrolled exothermic reaction (L6, Z5). Further, it was known from L10 that temperatures could reliably be maintained by a thermostatic jacket.

- 9.5 Therefore, a method for the safe transportation of a stabilized solution of cellulose in aqueous NMMO in a commercial pipeline by maintaining a low temperature such that the solution is still flowable by means of a thermostatic jacket, was obvious for the skilled person.
- 9.6 Therefore, the methods of Claims 1 and 2 according to the first auxiliary request lack an inventive step.

#### **Second auxiliary request**

#### 10. *Amendments*

- 10.1 Compared to Claim 1 according to the first auxiliary request, Claim 1 according to the second auxiliary request contains the amendment:  
"and the temperature of said solution in the centre of said pipe being at least 100°C" (last line of Claim 1).  
The same amendment has been made to Claim 2.
- 10.2 The added feature has its basis in Claim 13 as filed, which is identical to Claim 13 as granted, whereby Claim 13 was dependent from Claims 1 and 2 as filed.
- 10.3 In Claims 11 to 19 the numbering of the claims and their references to the previous claims have been adapted to the deletion of Claims 11, 13 and 16.
- 10.4 Therefore, the amendments do not introduce any ambiguities in the claims (Article 84 EPC) and are occasioned by the grounds of opposition (Rule 57a EPC).

Furthermore, the patent in suit has not been amended in such a way that it contains subject-matter which

extends beyond the content of the application as filed (Article 123(2) EPC) and Claims 1 and 2 according to the second auxiliary request have not been amended in such a way as to extend the protection conferred (Article 123(3) EPC).

11. *Novelty*

11.1 The novelty of the subject-matter of Claims 1 and 2 according to the second auxiliary request has not been contested. The Board sees no reason to take a different position.

12. *Inventive step*

12.1 For the same reasons as for the first auxiliary request, the closest prior art document is L6 (point 7.5.2, *supra*).

12.2 The problem underlying the patent in suit is to provide a method for safe transportation of a flowable solution of cellulose in aqueous NMMO through a pipe in industrial-scale plants at as high a temperature as possible, in order to reduce the pumping costs whilst preventing the occurrence of an uncontrolled exothermic reaction (in conformity with column 2, lines 20 to 23 and 28 to 48 as well as with column 5, lines 42 to 45).

12.3 The solution to that problem is represented by the methods defined in Claims 1 and 2 according to the second auxiliary request.

12.3.1 The proprietors argued that, based on their practical experience in existing industrial plants, the claimed

methods were effective in reducing the risk of the occurrence of uncontrolled exothermic reactions on the one hand and the pumping costs on the other hand.

12.3.2 This was not contested by the appellants.

12.3.3 Therefore, the problem underlying the patent in suit has been effectively solved.

13. It remains to be decided whether or not the claimed methods were obvious having regard to the cited prior art.

13.1 L6, in order to increase the stability of the cellulose solution, suggests the use of stabilizers permitting to process the cellulose solution at high temperatures for a long time. However, L6 is essentially concerned with processing the solution in twin screw extruders and nozzles, in which the residence time is shorter than in a chemical plant. L6 does not address the possible occurrence of an uncontrollable exothermic reaction under the conditions prevailing during the transport within a chemical plant. Therefore, L6 does not render obvious the subject-matter of Claims 1 and 2 according to the second auxiliary request.

13.2 Z5 contains no hint towards transporting a cellulose-NMMO-water solution at a temperature of at least 100°C within commercial pipelines, rather the opposite, so that it cannot supplement L6 in the direction of the claimed solution.

13.3 The same is valid for L10, which teaches the use of a thermostatic jacket to maintain an upper temperature in



installations where a danger of explosion exists. However, it does not suggest to maintain the temperature of a cellulose solution in aqueous NMMO transported in commercial pipelines at at least 100°C.

- 13.4 The other documents on file pursuant to Article 54(2) EPC, e.g. Z1, do not address the reduction of the occurrence of an uncontrolled exothermic reaction nor that of the pumping costs. Therefore, they contain no hint to the skilled person as to how to solve the above defined problem.
14. For the above reasons, the methods of claims 1 and 2 according to the second auxiliary request are inventive and the requirements of the EPC are fulfilled.
15. Since the second auxiliary request has been found to be allowable, the Board does not need to decide on the further requests.

Order

For these reasons it is decided that:


1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of claims 1 to 19 of the second auxiliary request filed with letter dated 27 April 2000 and a description yet to be adapted.

The Registrar:

The Chairman:



C. Eickhoff



R. Teschemacher

*Handwritten notes:*  
jhm 22/03/04  
D- 22/03/04