Examiners' Report Paper A 2011 (Chemistry)

Introduction

The paper relates to biodegradable superabsorbent polymers intended to be used for absorbing bodily fluids. The letter from the applicant describes polymers as well as absorbent products containing these polymers. The polymers described are obtained by cross-linking sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC). The superabsorbent polymers are made by a method comprising the following steps:

(i) reacting an aqueous solution of sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC) with a carbodiimide cross-linking agent in the presence of an acid catalyst to produce a polymer gel

(ii) washing the resulting gel in water, and

(iii) drying the gel

The absorbent products described in the applicant's letter comprise a liquid impermeable first layer, a second layer made from a non-woven material and an absorbent core between these two layers. The absorbent core is either simply the superabsorbent polymer or a mixture of superabsorbent polymer and fibres.
The applicant cites two prior art documents which are relevant for the invention. Document D1 discloses polymers obtained by cross-linking sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC) and their use in agriculture. The polymers in document D1 are made using a method which is the same as the method described in the applicant's letter. The reaction conditions described in the 2nd paragraph of page 4 of the applicant's letter are identical to the conditions described in paragraph [004] of document D1.The weight ratio of CMCNa and HEC in document D1 is 0.1 to 5.0, preferably 0.8 to 1.6 (for which examples are given). The polymer in document D1 is obtained as granules. The granules may be used as such or placed in a bag made from cellulosic fibres.
Document D2 discloses absorbent products for absorbing bodily fluids which comprise a liquid impermeable first layer, a second layer made from a non-woven material and an absorbent core between these two layers. The absorbent core is composed of a mixture of superabsorbent polymer and cellulosic fibres. The superabsorbent polymers used in document D2 are polyacrylics. Polyacrylic superabsorbent polymers are only poorly biodegradable.

Claims

The applicant in the letter (page 1, 1st paragraph) states that no claims fees would be paid. Therefore only the first 15 claims of each answer were awarded marks.

Independent claims (70 Marks)

Polymer

A claim to the polymer is expected. A suitable wording is: A superabsorbent polymer consisting of a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose, the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 2.0-3.0 (30 Marks).
The degree of cross-linking is stated to be essential for a useful superabsorbent polymer (see page 3, 3rd paragraph) and omitting this feature results in a deduction of 5 marks.
It is also necessary to ensure that the polymers are new and inventive with respect to document D1. The degree of cross-linking although not mentioned in document D1 does not establish the novelty as the conditions exemplified in document D1 will as stated in the applicant's letter result a degree of cross-linking of 2 to 10%. The claims thus have to be limited to polymers with a weight ratio of CMCNa to HEC of 2.0 to 3.0 (a range of 1.9-3.1 is also acceptable, a weight ratio of 2.4-3.0 resulted in a small deduction of marks); table 1 in example 1 shows that such a limitation results in polymers with significantly higher absorption capacities. Claims with this limitation represent an inventive selection from the polymers with weight ratios of 0.1-5.0 disclosed of document D1. Claims which defined novel subject-matter but contained weight ratio limitations which resulted in the claim lacking an inventive step have 12 marks deducted.
It is however not necessary to formulate the claim to a polymer as a product by process claim (such as by referring back to the independent claim for making the polymer or specifying that a carbodiimide was used to make the polymer) as the polymer can be defined otherwise. 10 Marks are deducted if such a form of claiming is used. It is not necessary to specify the degree of cross-linking in a product by process claim, when the process features specified inevitably result in a degree of cross-linking of 2-10%. In this case no marks are deducted for omitting this feature.
It is not necessary to specify the absorption capacity, water retention or shear modulus of the polymer. The polymers disclosed in the application all exhibit values for these parameters within the ranges stated to be essential (see page 4, 1st paragraph). In addition it is possible to define the polymer clearly without reference to these parameters. Thus defining values for these parameters in the claim is unnecessary and 5 marks are deducted.
2 marks are deducted for claims which lack clarity and no marks are awarded for claims which lack novelty.

Method for making the polymer

A suitable wording for a claim to a method for making the polymer is: A method for preparing the polymer of claim 1 comprising the following steps:

(i) reacting an aqueous solution of sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC) with a carbodiimide cross-linking agent in the presence of an acid catalyst to produce a polymer gel, where the sum of the concentrations of CMCNa

and HEC is 3 to 10 wt. %, the concentration of carbodiimide is 5-15 wt. % and the weight ratio of CMCNa to HEC is 2.0 to 3.0

(ii) washing the gel in water, and

(iii) drying the gel.

This method claim is worth 10 marks. The method has to contain all the features defined as being essential in the application (see page 3 first paragraph) and thus the concentration range for the sum of the sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC) concentrations as well as the concentration of carbodiimide have to be claimed. It is also necessary to realise that washing in deionised water (see page 2 final paragraph) and drying by phase inversion (see page 3, second paragraph) are not essential. Omitting the essential concentration ranges or defining the washing or drying steps more narrowly each result in deductions of 2 marks. The claim also has to define the weight ratio of CMCNa to HEC as being 2.0 to 3.0, since otherwise the claim will lack novelty with respect to the method employed in the example of D1. A method claim which lacks novelty is worth no marks.
It is also possible to formulate a method claim in which CMCNa and HEC are used at a weight ratio of 0.5 to 5.0 and where air drying is used to dry the polymer (document D1 only discloses phase inversion drying). The applicant's letter however states (see page 3, 2nd paragraph) that air drying results in a significantly lower absorption capacity than phase inversion drying. This method is thus clearly less preferred and worth 3 marks.

Absorbent product

A claim to an absorbent product for absorbing bodily fluids is also expected. This claim is worth 25 marks and may be worded as follows:
Absorbent product comprising a liquid impermeable backing sheet, a top sheet made from a non-woven material and an absorbent core containing a superabsorbent polymer consisting of a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose, the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 0.5-5.0.

The claim to an absorbent product must contain the backing sheet and the top sheet as well as the core containing the superabsorbent polymer (an acceptable alternative is to state that the product is for use in absorbing bodily fluids as the paper states that such products always have this structure). These features establish the novelty with respect to document D1 (a cellulosic fibre bag containing the polymer). An alternative is to claim an absorbent core containing the polymer as defined above mixed with fibres (or a mixture of the polymers and fibres). This alternative excludes the class of absorbent products which contain no fibres in the core. Specifying that a backing sheet and a top sheet are present excludes no products of interest as the applicant´s letter (page 1, 1st paragraph) states that absorbent products for bodily fluids always contain a backing and a top sheet. The claim to an absorbent core containing fibres is worth up to 20 marks. The expression absorbent core does not on its own establish novelty. The application states that an absorbent core may be polymer on its own. The bag containing polymer granules disclosed in document D1 also contains an absorbent core (the granules in the bag).

In the claim to the absorbent product the weight ratio of CMCNa to HEC should be broader than in the polymer and method claims (0.5-5.0). If the ratio is the same (2.0-3.0) as the

ratio in the claim to the polymer then 10 marks are deducted. The ratio of 0.5-5.0 and the degree of cross-linking of 2-10 % are essential features and omitting either one of them results in a deduction of 5 marks. Defining the absorbent product as a product by process results in a deduction of 10 marks.
Claims which define subject-matter which is not novel receive no marks. Claims which define absorbent cores containing only a polymer with a weight ratio of 0.5-5.0 or absorbent products comprising this polymer and fibres are anticipated by document D1. The applicant's letter states that an absorbent core may be superabsorbent polymer on its own and thus is anticipated by the polymer disclosed in document D1. The bag containing polymer disclosed in document D1 also comprises fibres and polymer.

The closest prior art for the absorbent product is document D2. The absorbent product differs from document D2 by the use of a different polymer. The problem solved with respect to D2 is providing biodegradable products without degrading the absorption properties. Example 1 in the letter shows this is solved.

Method for making the absorbent product

A claim can be formulated to a method for making an absorbent product which may be worded as follows:
A method for forming an absorbent product comprising mixing a polymer granules with fibres in hot air in a rotating vacuum drum to make an absorbent core and laminated between a liquid impermeable backing sheet and a top sheet made from a non-woven material, where the polymer is a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose, the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 0.5-5.0 (5 marks).
Only 3 marks are awarded if the method also includes the method for manufacturing the polymer.

General points:

If the independent claims under any one of the above headings fail to meet the requirements of Rule 43(2) EPC then 5 marks are deducted.

Dependent claims (15 Marks)

The most useful dependent claims are those directed to features which are stated to provide better products. Up to 15 marks can be awarded for dependent claims.
Washing in deionised water and phase inversion drying are both stated to increase absorbance and are each worth 2 marks. The preferred ranges for the pH, the sum of the concentrations of CMCNa and HEC and the concentrations of carbodiimide are each worth 1 mark.
Absorbent products containing fibres in the absorbent core are worth 2 marks. Cellulosic fibres are worth 5 marks. Example 2 demonstrates that when the polymers are mixed with such fibres an absorbent product is obtained which feels softer than the similar products using synthetic fibres. The products are also softer than absorbent products containing polyacrylics and cellulosic fibres. A claim directed to the cellulosic fibres mentioned in the letter (cotton, flax and rayon) and a claim directed to the types of absorbent products disclosed (baby diapers, adult incontinence items, female hygiene products and bandages) are each worth 2 marks. The use of the polymer with a weight ratio of CMCNA to HEC of 2.0-3.0 in the absorbent product is worth 2 marks. Polymers with a weight ratio of CMCNa to HEC of 2.4-3.0 (the range in which the highest absorption capacities are measured) are worth 4 marks.

Description (15 marks)

The discussion of the prior art is worth 5 marks, highlighting the basis for inventive step (stressing the effects associated with the novel features) is worth 5 marks. The remaining 5 marks are reserved for ensuring that the description is complete and consistent with the claims.

Model Claims

1. A polymer consisting of a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose, the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 2.0-3.0.

2. A polymer according to claim 1 in which the weight ratio of CMCNa to HEC is 2.4-3.0.

3. A method for preparing a polymer comprising the following steps:
(i) reacting an aqueous solution of sodium carboxymethylcellulose (CMCNa) and hydroxyethylcellulose (HEC) with a carbodiimide cross-linking agent in the presence of an acid catalyst to produce a polymer gel, where the sum of the concentrations of CMCNa and HEC is 3 to 10 wt.%, the weight ratio of CMCNa to HEC is 2.0-3.0 and the concentration of carbodiimide is 5-15 wt.%

(ii) washing the gel in water, and

(iii) drying the gel.

4. A method according to claim 3 in which the gel is washed in deionised water.

5. A method according to claim 3 in which the drying is by phase inversion.

6. Absorbent product comprising a liquid impermeable backing sheet, a top sheet made from a non-woven material and an absorbent core containing a superabsorbent polymer consisting of a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 0.5-5.0.

7. Absorbent product as defined in claim 6 in which the superabsorbent polymer is as defined in claims 1 or 2.

8. Absorbent product as defined in claims 6 or 7 in which the absorbent core is an intimate mixture of superabsorbent polymer and fibres.

9. Absorbent product as defined in claim 8 in which the fibres are cellulosic fibres.

10. Absorbent product as defined in claim 9 in which the cellulosic fibres are selected from cotton fibres, flax fibres and/or rayon fibres.

11. Absorbent product as defined in claims 6-10 in which the article is a baby diaper, an adult incontinence item, a female hygiene product or a bandage.

12. A method for forming an absorbent product comprising mixing a polymer granules with fibres in hot air in a rotating vacuum drum to make an absorbent core and laminated between a liquid impermeable backing sheet and a top sheet made from a non-woven material, where the polymer is a cross-linked mixture of sodium carboxymethylcellulose and hydroxyethylcellulose, the polymer having a degree of cross-linking of 2-10% and the weight ratio of CMCNa to HEC being 0.5-5.0.

EXAMINATION COMMITTEE I

Candidate No.

Paper A (Chemistry) 2011 - Marking Sheet

Category		Maximum possible	Marks awarded	
			Marker	Marker
Independent claims	Polymer	30		
	Method / polymer	10		
	Absorbent product	25		
	Method / absorbent product	5		
Dependent claims		15		
Description		15		
Total		**100**		

Examination Committee I agrees on ..... marks and recommends the following grade to the Examination Board:

☐ PASS (50-100)

☐ COMPENSABLE FAIL (45-49)

☐ FAIL (0-44)

30 June 2011

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Chairman of Examination Committee I