

DETERGENT COMPOSITION CONTAINING A POLYIMIDE BIOPOLYMER
WHICH CAN BE HYDROLYSED IN A WASHING LIQUOR

The present invention relates to a detergent composition containing a polyimide biopolymer capable of giving rise, on hydrolysis in a washing liquor, to a biodegradable polypeptide builder; this composition may be used for the formulation of detergents or cleaning products in powder form.

Builder is understood to mean any constituent which improves the performance of the surfactants in a detergent composition. Generally speaking, a builder has a plurality of functions:

- it effects the removal of undesirable ions, in particular alkaline earth metal (calcium, magnesium) ions, in a washing liquor, by sequestration or precipitation, to prevent the precipitation of anionic surfactants,

- it provides a reserve of alkalinity and of ionic strength,

- it maintains the extracted soiling in suspension

- it prevents mineral incrustation of the laundry observed during washing.

For a very long time, tripolyphosphates have been the builders most frequently used in detergent compositions and washing products. However, they are partially responsible for the eutrophication of lakes and slowly flowing water when they are not adequately removed by water purification plants; an effort is thus being made to replace them partially or completely.

Zeolites alone cannot replace tripolyphosphates; their action has to be reinforced by other additives.

Copolymers of acrylic acid and maleic anhydride (or their alkali metal or ammonium salts) have been proposed (EP-A-25,551) as incrustation

inhibitors. They possess, however, the drawback of not being biodegradable in a natural environment.

- DE-A-3,724,460 describes the use of a polypeptide biopolymer rather than a polyimide biopolymer in liquid detergent compositions,

- US-A-4,696,981 describes polyimide biopolymers derived from the polycondensation of amino acids which are readily hydrolytised in an alkaline aqueous medium,

-WO-A-8,703,891 describes the property of sequestering calcium ions for polyaspartic and/or polyglutamic acid derivatives and their use for preparing medicinal products.

The Applicant has now found a detergent composition possessing excellent properties of primary and secondary detergency, one of the constituents of which composition is a polyimide biopolymer capable of giving rise, on hydrolysis in a washing liquor, to an at least partially biodegradable builder.

Detergent composition denotes, according to the invention, detergents for washing laundry, dishwasher detergents or any other washing product for household use.

"Washing bath" or "washing liquor" is understood to mean the aqueous solution of detergent (detergent composition) present in the washing machine during the washing cycles; the amount of detergent present is that recommended by the manufacturer; it is generally less than 20 g/litre; the pH of such a solution is above 9.

According to the invention, the composition in question is a detergent composition containing a polymer and a surfactant, characterized in that the said polymer is a polyimide biopolymer possessing a charge density which can range from 0 to 5×10^{-4} mol/g of polymer and capable of giving rise, on hydrolysis in a basic washing liquor, to an at least partially

biodegradable polypeptide builder capable of acquiring a COO^- charge density equal to at least 10^{-3} mol/g of polymer.

5 The present invention also relates to the use, in detergent compositions in powder form, of a polyimide biopolymer possessing a COO^- charge density which can range from 0 to 5×10^{-4} mol/g of polymer and capable of giving rise, on hydrolysis in a basic washing liquor, to an at least partially biodegradable
10 polypeptide builder.

As an example of polyimide biopolymers which can be employed, there may be mentioned polyimides derived from the polycondensation of amino diacids, in particular aspartic or glutamic acid, or of the
15 precursors of the said amino diacids; these polymers dissolve in water at basic pH with the formation of free COO^- functions.

These polymers can be either homopolymers derived from aspartic or glutamic acid, or copolymers
20 derived from aspartic acid and glutamic acid in any proportions, or copolymers derived from aspartic and/or glutamic acid and other amino acids (for example up to 15 % by weight, and preferably less than 5 % by weight, of other amino acids).

25 Among amino acids which can be copolymerized, glycine, alanine, valine, leucine, isoleucine, phenylalanine, methionine, tryptophan, histidine, proline, lysine, arginine, serine, threonine, cysteine, etc., may be mentioned.

30 The said polyimide biopolymers can possess a weight average molecular mass of the order of 2,000 to 10^7 , and generally of the order of 3,500 to 60,000.

These biopolymers, in particular the polyimides derived from aspartic or glutamic acid, may
35 be prepared, in particular, by thermal condensation of the said amino diacid or diacids in a substantially anhydrous medium, as described in J.A.C.S., 80, 3361

(1958), J. Med. Chem. 16, 893 (1973), Polymer 23, 1237 (1982) or in US Patent No. 3,052,655.

The said polyimides preferably possess a zero COO⁻ charge density; they can, however, be partially hydrolysed (by opening of a few imide rings with the formation of alkali metal or ammonium carboxylates), the COO⁻ charge density having, however, to be less than 5×10^{-4} mol/g of polymer.

The amount of polyimide biopolymer participating in the detergent composition which forms the subject of the invention can range from 0.2 to 80 %, and preferably from 2 to 5 %, of the weight of the said detergent composition.

Besides the polyimide biopolymer, a surfactant is present in the detergent composition, in an amount which can range from 2 to 50 %, and preferably from 6 to 30 %, of the weight of the said detergent composition.

Among the surfactants participating in the detergent composition which forms the subject of the invention, there may be mentioned:

- anionic surfactants of the type comprising alkali metal soaps (alkali metal salts C₈-C₂₄ fatty acids), alkali metal sulphonates (C₈-C₁₃ alkylbenzenesulphonates, C₁₂-C₁₆ alkylsulphonates, oxyethylenated and sulphated C₆-C₁₆ fatty alcohols, oxyethylenated and sulphated C₈-C₁₃ alkylphenols), alkali metal sulphosuccinates (C₁₂-C₁₆ alkyl sulphosuccinates), etc,
- nonionic surfactants of the type comprising polyoxyethylenated C₆-C₁₂ alkylphenols, oxyethylenated C₈-C₂₂ aliphatic alcohols, ethylene oxide/propylene oxide block copolymers, carboxylic amides, optionally polyoxyethylenated,
- amphoteric surfactants of the alkyldimethylbetaine type,
- cationic surfactants of the

alkyltrimethylammonium and alkyl dimethylethylammonium chloride or bromide type.

Various constituents can additionally be present in the detergent composition of the invention in order to obtain detergents or cleaning products in powder form.

Thus, the following can additionally be present in the detergent composition described above:

- builders of the type comprising:
 - phosphates in the proportion of less than 25 % of the total weight of formulation,
 - zeolites up to approximately 40 % of the total weight of formulation,
 - sodium carbonate up to approximately 80 % of the total weight of formulation,
 - nitriloacetic acid up to approximately 10 % of the total weight of formulation,
 - citric acid, tartaric acid up to approximately 20 % of the total weight of formulation, the total amount of builder (builder-precursor polyimide + other builders) corresponding to approximately 0.2 to 80 %, and preferably from 20 to 45 %, of the total weight of the said detergent composition,
- corrosion inhibitors such as silicates up to approximately 25 % of the total weight of the said detergent composition,
- bleaching agents of the perborate, chloroisocyanate, N,N,N',N'-tetraacetylenediamine (TAED) type up to approximately 30 % of the total weight of the said detergent composition,
- antiredeposition agents of the carboxymethylcellulose, methylcellulose type in amounts which can range up to approximately 5 % of the total weight of the said detergent composition,
- anti-incrustation agents of the acrylic

acid/maleic anhydride copolymer type in an amount which can range up to approximately 10 % of the total weight of the said detergent composition,

5 - fillers of the sodium sulphate type for detergents in powder form, in an amount which can range up to 50 % of the total weight of the said detergent composition.

10 The detergent composition which forms the subject of the invention possesses good efficacy in both primary detergency and secondary detergency. In addition, the incorporation of a polyimide which can be hydrolysed only in the washing liquor ensures that the detergent composition has a stability on storage
15 the biodegradable polypeptide.

 The examples and figures which follow are given as a guide, and cannot be considered as limiting the scope and spirit of the invention.

20 Figure 1 shows the variation in the level of a calcium carbonate deposit in terms of the polymer concentration. Figure 2 shows the variation in the filming phenomenon in terms of the hardness of the water in the presence or absence of a composition according to the invention.

25 Example 1

Synthesis of a polysuccinimide derived from aspartic acid

30 The apparatus consists of a one-litre reaction flask heated in an oil bath, the said reaction flask being surmounted by a distillation column which is itself connected to a recovery flask cooled to room temperature (distillation assembly).

35 250 g of L-aspartic acid are introduced into the reaction flask. The latter is purged with nitrogen; the pressure is lowered to 8×10^3 Pa; the recovery flask is maintained at 20°C while the reaction medium

is heated to 220°C for 6 h 30 min.; the resulting water is collected in the recovery flask at 20°C.

182.2 g of a powder which is a polysuccinimide (IR spectrometry), the number average molecular mass M_n of which = 2,450 (viscosity measurement in 0.5 N NaOH) and which possesses no anionic charge, are recovered.

Example 2

Formulation of a detergent composition for washing laundry using the polysuccinimide of Example 1

Various additives are introduced by dry mixing into the powder prepared in Example 1 in order to obtain the following detergent (washing) composition:

15	Composition of the detergent	% by weight
	- linear alkylbenzenesulphonate	7.5
	- CEMUSOL LA 90 [®] (polyoxyethylenated lauric acid marketed by S.F.O.S.)	4
	- zeolite 4 A	24
20	- Na silicate ($\text{SiO}_2/\text{Na}_2\text{O} = 2$)	1.5
	- Na carbonate	10
	- TAED	2
	- Na perborate	15
	- ethylenediaminetetraacetic	0.1
25	- polysuccinimide prepared above	3
	- Tinopal DMSX [®]	0.1
	- Tinopal SOP [®]	0.1
	(optical bleaches marketed by CIBA-GEIGY)	
30	- silicone antifoam	0.2
	- alcalaze	0.15
	- savinaze	0.15
	(enzymes)	
	- Na sulphate	qs 100 %

The term "control detergent" will be used to designate a detergent of the above composition but not containing polysuccinimide.

5 The performance of this detergent was tested in respect of primary and secondary detergency. These are explained in the examples which follow.

Example 3

Performance of the detergent for washing laundry of Example 2 in respect of primary detergency

10 The "primary" effects of detergency relate to the removal of soiling or stains, and are observed after a single wash.

Washing of laundry is performed under conditions as close as possible to actual laundering conditions, by means of the use of an AEG® brand drum-type household machine.

A 5 kg load of laundry consisting of a mixture of cloths and terry towels is used as a support for control test pieces which are sewn on the cloths.

20 These test pieces are fabrics soiled in a standard manner and supplied by specialist laboratories.

They comprise 5 test pieces (10 cm x 10 cm) of each of the following three fabrics:

- 25 - soiled cotton EMPA 101® (St-Gall)
(1)
- soiled polyester-cotton EMPA 104
(St-Gall)®
(2)
30 - soiled cotton TNO (3)

The reflectance of these fabrics is measured (before they are sewn) using a XENOCOLOR® reflectometer (marketed by Dr. LANGE), according to the 3 trichromatic coordinates Y, L, E.

35 Washing is performed at 75°C, introducing 120 g of detergent to be tested into the receptacle of

the machine (detergent concentration 8 g/l).

After drying of the laundry, all the initially soiled test pieces are unsewn and their coordinates Y, L, E are measured again.

5 The differences ΔY , ΔL , ΔE from the initial values indicate the detergency performance of the detergent on the various types of soilings; the differences observed are directly proportional to the detergency effect of the detergent tested.

10 The results for primary detergency are given in Table I.

TABLE I

15	Fabric	Reflectance	
		Control detergent	Detergent of Example 1
20	(1)	$\Delta Y = 23.8$	$\Delta Y = 26.6$
		$\Delta L = 23.2$	$\Delta L = 26.0$
		$\Delta E = 23.7$	$\Delta E = 26.5$
25	(2)	$\Delta Y = 25.9$	$\Delta Y = 27.8$
		$\Delta L = 25.6$	$\Delta L = 27.8$
		$\Delta E = 25.8$	$\Delta E = 28.0$
30	(3)	$\Delta Y = 18.8$	$\Delta Y = 21.3$
		$\Delta L = 19.7$	$\Delta L = 22.4$
		$\Delta E = 20.1$	$\Delta E = 23.3$

Example 4

30 Performance of the detergent for washing laundry of Example 2 in respect of secondary detergency

"Secondary" effects of detergency are observed after a run of several consecutive washes; these effects are defined by the "redeposition" of the

soiling on the initially clean fabrics, and by the "incrustation" of precipitates which can be produced during the wash, on these same fabrics.

Antiredeposition effect

5 This effect is measured on 5 test pieces
(10 cm x 10 cm) of each of the following unsoiled
fabrics:

- Testfabric 405 cotton textile (4)
- Krefeld cotton 10 A (5)
- 10 - mixed linen/cotton cloth (6)
- DACRON® white polyester (7)

 These unsoiled test pieces are washed as in
Example 2 in the presence of the soiled test pieces of
15 Example 2, this being done 5 times under the same
conditions.

 After each wash, the unsoiled test pieces are
not unsewn. The washed soiled test pieces are replaced
by other soiled test pieces, which thus constitute a
20 fresh source of soiling for the next wash, which is
carried out again under the same conditions.

 The operation is repeated five times and,
following this run of five consecutive washes, the
initially clean test pieces are unsewn after drying.

25 The coordinates Y, L, E of the initially
clean test pieces (4) to (7) are then measured; the
differences ΔY , ΔL , ΔE obtained give the cumulative
"redeposition" or "greying" after 5 washes.

 The results obtained appear in Table II.

30 The differences in reflectance should be as
low as possible.

TABLE II

	Fabric	Reflectance	
		Control detergent	Detergent of Example 1
5	(4)	$\Delta Y = - 3.5$ $\Delta L = - 1.9$ $\Delta E = + 2.4$	$\Delta Y = - 2.7$ $\Delta L = - 1.5$ $\Delta E = + 2.1$
10	(5)	$\Delta Y = - 3.9$ $\Delta L = - 2.1$ $\Delta E = + 2.6$	$\Delta Y = - 2.8$ $\Delta L = - 1.5$ $\Delta E = + 2.1$
15	(6)	$\Delta Y = - 3.3$ $\Delta L = - 1.9$ $\Delta E = + 2.8$	$\Delta Y = - 2.7$ $\Delta L = - 1.5$ $\Delta E = + 2$
20	(7)	$\Delta Y = - 13.0$ $\Delta L = - 7.6$ $\Delta E = + 10.5$	$\Delta Y = - 10.5$ $\Delta L = - 6.1$ $\Delta E = + 9.3$

Inhibitory effect on incrustation

This effect was measured after 20 washes in the absence of soiled fabrics on the following unsoiled test pieces:

- Testfabric 405 cotton textiles (4)
- Krefeld cotton 12A (8)

The mineral incrustation is calculated from the ash content (in % relative to the total weight of cotton) of the fabrics washed, dried and incinerated at 950°C for 3 hours).

The inhibitory effect on incrustation is assessed by the ratio ash content with additives/ash content without additive which appears under the

letter T in Table III below.

TABLE III

	Ash content %		
<u>Fabric</u>	Control detergent	Detergent of Example 2	T
(4)	3.7 %	2.4 %	65 %
(8)	4.1 %	1.1 %	26 %

Example 5

This example demonstrates the capacity for sequestration of calcium ions of the polysuccinimide of Example 1 after in situ hydrolysis to polyaspartic acid in a basic medium.

The capacity for sequestration of calcium ions is measured using an electrode possessing a calcium ion-permeable selective membrane.

A calibration curve is first plotted employing 100 ml of a sodium chloride solution containing 3 g/l, pH 10.5, to which amounts of calcium ions varying from 10^{-5} to 3×10^{-3} mol/l are added, and the curve of potential delivered by the electrode is plotted in terms of the concentration of free Ca^{2+} ions.

The polysuccinimide of Example 1 is hydrolysed with concentrated sodium hydroxide solution until a solution containing 20 % by weight of sodium polyaspartate, pH 10.5, is obtained. The solution obtained is termed the "hydrolysate".

This solution is diluted until 100 g of

aqueous solution containing 10 g/l of polyaspartate are obtained; the pH is adjusted to 10.5 with concentrated sodium hydroxide solution. 0.3 g of powdered sodium chloride is added.

5 The straight line

$$[\text{Ca}^{2+}] \text{ free} / [\text{Ca}^{2+}] \text{ bound} = f ([\text{Ca}^{2+}] \text{ free})$$

is plotted. From this straight line, the following are determined:

- the calcium ion-complexing constant K of
- 10 the polymer
- the number S_0 of complexing sites of the polymer,

defined by:

$$\frac{[\text{Ca}^{2+}] \text{ free}}{[\text{Ca}^{2+}] \text{ bound}} = \frac{1}{K S_0} + \frac{1}{S_0} [\text{Ca}^{2+}] \text{ free}$$

15

According to this method of evaluation, it is found that the polyaspartic acid obtained by hydrolysis of the polysuccinimide of Example 1 possesses 2.5×10^{-3} site/g of polymer, the affinity of which is

20 $\text{Log } K = 3.5$.

Example 6

This example demonstrates the capacity of the polysuccinimide of Example 1 for dispersing calcium carbonate, after in situ hydrolysis to aspartic acid in

25 a basic medium.

In a 100-cm³ test tube (height 26 cm; diameter 3 cm), 2 g of precipitated calcium carbonate are dispersed in 100 ml of an aqueous solution, pH 10.5 (NaOH) containing 3 g/l of NaCl, 3×10^{-3} mol/l of CaCl₂

30 and the hydrolysate as prepared in Example 4, at various concentrations.

The level of the deposit in cm³ after 10 min is measured, and the curve of level of deposit is plotted in terms of the concentration in ppm of the

35 polymer (expressed on a dry basis).

The curve in Figure 1 shows, first a

flocculation phenomenon (too low a degree of covering of the particles by the polymer), then restabilisation.

This capacity for stabilisation of inorganic particles is especially advantageous, since it is known that the latter of the source of the incrustation phenomena due to the deposits which accumulate on cotton.

Example 7

This example demonstrates the capacity of the polysuccinimide of Example 1 for dispersing carbon black and iron oxide (particles encountered in the commonest types of soiling), after in situ hydrolysis to polyaspartic acid in a basic medium.

1 % by weight of carbon black or of iron III oxide is introduced into an aqueous solution, pH 10.5 (NaOH), containing 3 g/l of NaCl, 3×10^{-3} mol/l of CaCl_2 and 1,000 ppm of the hydrolysate (expressed on a dry basis) as prepared in Example 4.

It is found that the suspensions obtained are stable over time.

In the absence of polymer, they settle in less than 10 minutes.

This capacity for stabilisation of carbon black and iron III oxide is advantageous, since it is known that the phenomenon of redeposition is the consequence of poor maintenance of this type of soiling in suspension in the detergent bath.

Example 8

This example demonstrates the property of the succinimide of Example 1 of inhibiting the crystallization of calcium carbonate, after in situ hydrolysis to polyaspartic acid in the basic medium.

The property of this product of inhibiting crystallization of calcium carbonate is demonstrated using the method described by Z. Amjad in

Langmuir 1987, 3, 224-228.

The measurement is carried out in a thermostated closed cell using a supersaturated solution containing 10^{-3} mol/l of sodium bicarbonate and 2×10^{-3} mol/l of calcium chloride (pH 8.6), to which 5 g/l of synthetic calcium carbonate (specific surface area = $80 \text{ m}^2/\text{g}$; theoretical diameter = 20 nm) are added; the decrease in the rate of crystallization of the calcium carbonate, obtained by adding 500 ppm of the hydrolysate (expressed on a dry basis) as prepared in Example 4, is measured.

The results are as follows:

	Without polymer	With polymer
Rate of crystallization in mole/l.s.	5×10^{-7}	4.5×10^{-8}

Example 9

The objective of this example is to measure the biodegradability of the polyaspartic acid obtained after in situ hydrolysis of the polysuccinimide in a basic medium.

The "ultimate" biodegradability of the hydrolysate as prepared in Example 5 is measured according to AFNOR Standard T90-312 (complying with international standard ISO 7827).

The test is carried out using:

- an inoculum obtained by filtration of inflow water of the Saint Germain municipal purification plant at Mont d'Or (Rhône)
- a test medium containing 4×10^7 bacteria/ml
- an amount of test product such that the test medium contains a concentration of organic carbon of the order of 40 mg/l. The

degree of biodegradability of the product under test in terms of time is 75 % in 28 days under the conditions of disposal in stream water.

5 The examples above clearly show all the advantages of the use in detergent compositions of the polysuccinimide of Example 1, namely:

- its effects of primary and secondary detergency
- 10 - the observed builder effect following its in situ hydrolysis in a basic medium
- the very high biodegradability of polyanion emanating from the washing bath at outflow from the machine.

15 Example 10

Formulation of dishwasher detergent compositions using the polysuccinimide of Example 1

20 Table IV below reports the composition of two dishwasher detergents C and D incorporating the polysuccinimide and a control detergent B without polysuccinimide.

TABLE IV

		FORMULA B	FORMULA C	FORMULA D
5	Na ₂ CO ₃	60 %	60 %	60 %
	DISILICATE	28 %	28 %	28 %
	PERBORATE TETRA SALT	6 %	6 %	6 %
	SURFACTANT	1 %	1 %	1 %
10	SULPHATE	5 %	0 %	0 %
	POLYMER	0 %	PSI: 5 %	PA: 5 %

PSI: Polysuccinimide

PA: Poly(sodium acrylate) M = 2,100 g/mol

15 Surfactant: Pluronic L 64[®]

The mixtures were prepared by dry mixing in a Lödige mixer. All the powders were incorporated, and then mixed for approximately 5 minutes. The surfactant is then run slowly into the mixture via a dropping
 20 funnel. The detergent obtained is fluid and does not aggregate in lumps. Its density is 1.05 g/cm³ and the pH of a 10 % detergent solution is 11.

The chosen formula is intentionally a formula which deposits a substantial bloom on the slabs. This
 25 is due to the massive presence of carbonates and to the absence of complexing agents such as citrate.

Example 11

Evaluation of the antifilming capacity of the dishwasher detergent compositions of Example 10.

Apart from the actual washing, that is to say the removal of soiling deposited on the cooking or feeding implements, the appearance of glasses is definitely the feature of which the user is made most aware. The quality of the rinse and of the drying are thus predominant. It is customary to use the term filming or spotting to characterize these defects of appearance.

The experiments were performed in a MIELE G 560[®] automatic dishwasher possessing a short programme at 65°C with a final hot rinse and a drying. The total duration of the cycle is approximately 50 minutes. No rinsing product was used.

A sequence of consecutive washing/drying runs is then performed on a series of 10 glass slabs measuring 20 cm x 20 cm. Initially, the glassware is clean and free from defects. At the start, the softener incorporated in the machine is fully regenerated.

During the first washes, the hardness of the water is low and does not change with the number of consecutive washing runs. Then, when the water softener reaches the end of its ability to function, the hardness of the water increases and a film begins to appear on the glass slabs. During the washes, the hardness of the rinsing water and the changes in the transparency of the glass slabs are monitored.

The appearance of the glassware is measured every other wash using a GARDNER[®] spectrometer, superposing a black slab on the glass slab to be measured. In this manner, the increase in opacity of the bloom is followed by the parameter L measured in the GARDNER[®] spectrometer. The higher the value of L, the more substantial the bloom. 20 measurements are performed on each slab.

After these measurements are made, the value of L is plotted on a graph in terms of the hardness of the water.

2 preliminary tests are performed: a first test without detergent, enabling the effect of the water alone on the filming to be discerned. The second test involves a detergent without polymer. The
5 detergent concentration is 5 g/l (50 g for an amount of water of 10 litres per wash). The results are presented in Figure 2.

Example 12

Preparation of a polyimide derived from an
10 aspartic acid/glutamic acid copolymer.

A stainless steel beaker containing 285 g of aspartic acid and 315 g of glutamic acid, which corresponds to 600 g of an equimolar mixture, is placed in an oven which incorporates nitrogen flushing. The
15 mixture is heated to 175°C for approximately 22 h.

The polymer is then cooled using dry ice. It is ground in an Ultraturax® in suspension in 2.5 l of water.

It is then washed 3 times with 2.5 l of water
20 and thereafter once in 0.5 l of ethanol.

After drying in the oven, 213 g of copolymer are obtained.

Example 13

The hydrolysate of the polyimide of
25 Example 12 is tested for its capacity for sequestration of calcium ions, its calcium carbonate-dispersant power and its growth-inhibitory power according to the protocols described, respectively, in Examples 5, 6 and 8.

Table V below reports the results.

TABLE V

	So mM/g	Log K	Dispersant power ppm	Rate of crystallization (mol/l.s)
Example 12	1.8	3.2	250 ppm	1.3×10^{-8}

Example 14

In accordance with the procedure described in Example 2, a detergent composition for washing laundry is prepared from the polyimide of Example 12. The inhibitory effects of this detergent on incrustation, the detergent being tested according to the protocol described in Example 4, are as follows:

Fabrics	T
(4)	30 %
(8)	29 %

CLAIMS

1. Detergent composition containing a polymer and a surfactant, characterized in that the said polymer is a polyimide biopolymer possessing a charge density which can range from 0 to 5×10^{-4} mol/g of polymer and capable of giving rise, on hydrolysis in a basic washing liquor, to an at least partially biodegradable polypeptide builder capable of acquiring in the washing bath a COO^- charge density equal to at least 10^{-3} mol/g of polymer.
2. Detergent composition according to claim 1, characterized in that the said polyimide biopolymer is derived from the polycondensation of amino acids or of the precursors of the said amino acids.
3. Detergent composition according to claim 1 or 2, characterized in that the said polyimide biopolymer is derived from the polycondensation of aspartic acid and/or glutamic acid or of the precursors of the said acid or acids.
4. Detergent composition according to any one of claims 1 to 3, characterized in that the said polyimide biopolymer possesses a weight average molecular mass of the order of 2,000 to 10^7 .
5. Detergent composition according to claim 4, characterized in that the said polyimide biopolymer possesses a weight average molecular mass of the order to 3,500 to 60,000.
6. Detergent composition according to any one of claims 1 to 5, characterized in that the said polyimide biopolymer represents from 0.2 to 80 % of the weight of the said detergent composition.
7. Detergent composition according to claim 6, characterized in that the said polyimide biopolymer represents from 2 to 5 % of the weight of the said detergent composition.
8. Detergent composition according to any one of claims 1 to 7, characterized in that the surfactant is



present in an amount ranging from 2 to 50 % of the weight of the said composition.

9. Use, in detergent compositions in powder form, of a polyimide biopolymer possessing a COO^- charge density which can range from 0 to 5×10^{-4} mol/g of polymer and capable of acquiring, on hydrolysis in a basic washing liquor, a COO^- charge density equal to at least 10^{-3} mol/g of polymer, as a substance which generates an at least partially biodegradable polypeptide builder component.
10. Use according to claim 9, characterized in that the said polyimide biopolymer is derived from the polycondensation of amino diacids or of the precursors of the said amino diacids.
11. Use according to claim 9 or 10, characterized in that the said polyimide biopolymer is derived from the polycondensation of aspartic acid and/or glutamic acid or of the precursors of the said acid or acids.
12. Use according to any one of claims 9 to 11, characterized in that the said polyimide biopolymer possesses a weight average molecular mass of the order of 2,000 to 10^7 .
13. Use according to claim 12, characterized in that the said polyimide biopolymer possesses a weight average molecular mass of the order of 3,500 to 60,000.
14. Use according to any one of claims 9 to 13, characterized in that the said polyimide biopolymer is present in an amount ranging from 0.2 to 80 % of the weight of the said detergent composition in powder form.

