

- 1 -

CREPING AID

The present invention relates to a creping aid composition and, in particular, a creping aid composition for application to a creping drum (also known as a Yankee or MG cylinder) in an apparatus for producing soft, lightweight paper web suitable for making sanitary paper products such as bathroom and facial tissue, papers towels and napkins.

It is conventional practice to produce soft paper web by mechanically or chemically disrupting interfibre bonds in the paper web. Such practices include the use of a creping or doctor blade to crepe paper from a drying surface. This procedure usually involves the application of a creping aid composition to the surface of the creping cylinder immediately prior to the web contacting the cylinder. The creping aid composition causes substantial adherence of the web to the creping cylinder at the point of contact with the creping blade. Under these conditions, a high bulked and internally delaminated web is produced.

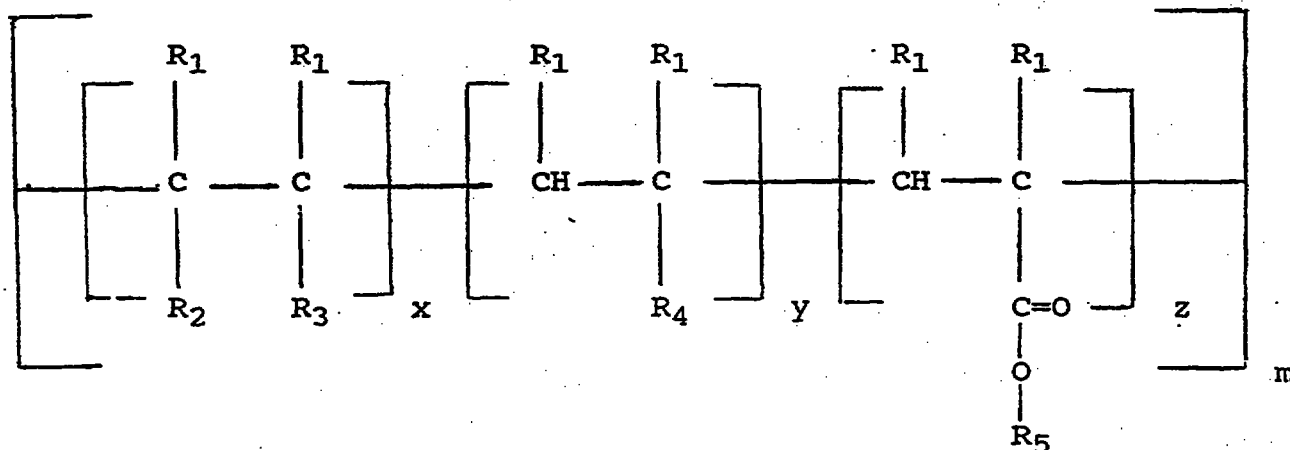
The creping aids which are widely used include polyvinylalcohol, ethylene-vinyl acetate copolymers, animal glues, polyvinylacetate and cationic polyaminoamide wet strength resins. These nonionic and cationic polymers may be used alone or in combination with each other. However they are generally all used with a release agent, typically

an imidazoline. In practice it is normal to vary the composition of the blend which is applied to the creping cylinder in order to control the adhesion of the web to the cylinder surface.

It has now surprisingly been found, according to the present invention, that the use of certain synthetic anionic polymers give superior controlled adhesion properties. In other words when these polymers are applied to the creping cylinder the web adheres better to the cylinder with the result that improved creping takes place. Also, while it is desirable to use such polymers in combination with a release agent it has been found that the concentration of release agent employed can be significantly reduced compared to the levels currently used with conventional creping aids. Accordingly, the present invention provides a method of creping a paper which comprises applying to the creping drum (prior to the application of the paper web to be creped) a synthetic anionic polymer as defined below and, preferably also, a release agent.

It has been found that the resulting paper sheet is of superior bulk and softness even though significantly lower amounts of the polymer and release agent are employed as compared with the amounts conventionally used with convention creping aids.

The polymers used in the present invention are random copolymers which can be represented by the following formula:



wherein:-

each R_1 individually represents H or a C_1 to C_8 alkyl group

R_2 represents H, $-\text{CO}_2\text{X}$ or $-\text{CH}_2\text{CO}_2\text{X}$ and

R_3 represents $-\text{CO}_2\text{X}$,

or R_2 and R_3 together represent $-\text{CO}-\text{O}-\text{CO}-$,

R_4 represents $-\text{CONH}_2$ or $-\text{CON}(\text{CH}_3)_2$

R_5 represents a C_1 to C_8 alkyl group

X represents H or NH_4 or an alkali metal

m is an integer from 3 to about 100

x, y, z individually represent the relative mole ratios of each monomer such that x and y are from 1 to 9 and z can be from 0 to 5, with the proviso that when R_1 and R_2 are hydrogen, R_3 is $-\text{CO}_2\text{X}$ and R_4 is $-\text{CONH}_2$, z is not 0.

It will be appreciated that the formula does not mean that the first recurring unit is in a block of x units etc ..

Preferred copolymers for use in the present invention are random copolymers of

- A acrylic acid and/or methacrylic acid with
- B acrylamide and/or methacrylamide with, optionally,
- C an alkyl acrylate or alkyl (meth) acrylate ester, except that when A is acrylic acid and B is acrylamide, C is present, present in the specified proportions so as to impart water solubility to the copolymer.

The mole ratios of A to B is generally from 1:9 to 9:1 but preferably from 1:5 to 5:1. Up to, say, 50 mole percent of A to B may be replaced by C.

The molecular weight range of the polymers used in the present invention is generally 1,000 to 500,000 but preferably 5,000 - 100,000 and especially 5,000 to 25,000 (Mw as determined by gel permeation chromatography). Thus particularly preferred polymers for use in the present invention include copolymers of methacrylic acid and acrylamide, especially those with a mole ratio (respectively) of 1:5 to 5:1.

The copolymers used in the present invention can generally be prepared by the usual free-radical type

polymerisation conditions in aqueous media. Although it is possible to obtain certain acrylic acid copolymers by hydrolysing polyacrylamide, it will be appreciated that the copolymers used in the present invention derived from methacrylic acid cannot be prepared by partial hydrolysis in this way because, of course, hydrolysis of acrylamide will yield only acrylic acid and not methacrylic acid.

The usual release agents can be employed with the anionic polymers. These include imidazolines as well as oils such as mineral oil defoamers and other defoaming agents including quaternary surfactants which have a softening effect on the paper web. It will be appreciated that, for greater control, the polymer and release agent will normally be applied separately.

The amounts used will, of course, depend very much on the nature of the paper and the degree of softness to be obtained. But, in general, from 0.1 to 0.3 grams of polymer is required per square metre of surface of the creping drum.

The present invention will now be illustrated by the following Examples; products A to E and I to K are included for comparative purposes.

METHOD I

- a) The sample was applied at 10% ds to a stainless steel panel (dimension 2" x 5"). The sample was spread as evenly as possible across the surface.

- b) The sample was air dried in a fan oven without heat.
- c) The panel was placed onto a laboratory hot plate (DATAPLATE, digital hotplate and stirrer) and heated to a surface temperature of 93°C.
- d) A wet cotton cloth (dimensions 2" x 8") containing approximately three times its weight of water was applied to the hot panel to cover the surface and pressed onto the panel by rolling over it a 2kg cylinder.
- e) While the cloth dried on the hot plate the surface temperature was raised to 99°C.
- f) When the cloth was dry it was peeled off by hand at an angle of 180 degrees. The degree of adhesiveness was noted on a scale from 1 to 5 (1 being very adhesive and 5 being not adhesive at all).

EXAMPLES

<u>PRODUCT</u>	<u>ADHESIVENESS</u>	<u>CHEMICAL CHARACTERISTICS</u>
A	2	Polyamide/EPI wet strength resin
B	5	Polyvinylalcohol
C	3	Polyamide/EPI wet strength resin
D	2	Polyvinylacetate (MW 500,000 - 1,500,000)

E	2	Polyvinylacetate (MW 5,000 - 20,000)
F	5	Methacrylic/acrylamide 1:4 Copolymer (MW 18,00)
G	4	Methacrylic/acrylamide 1:2 Copolymer (MW 10,000)
H	2	Methacrylic/acrylamide 1:1 Copolymer (MW 10,000)

The molecular weights of the copolymers were determined by gel permeation chromatography.

METHOD II

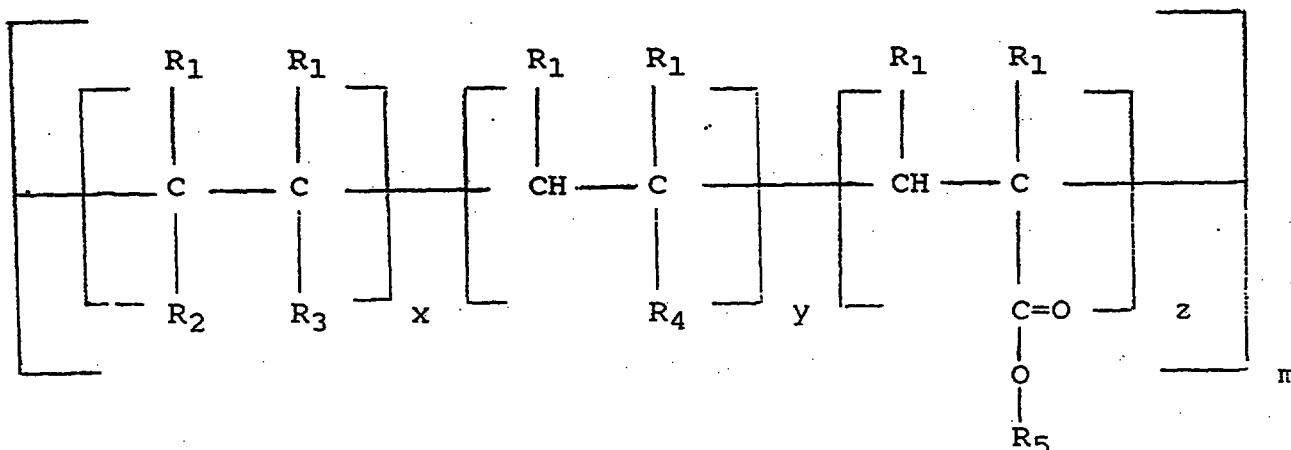
- a) The samples were applied to a 2" x 5" stainless steel panel as evenly as possible.
- b) The panel was placed onto a laboratory hot plate (DATAPLATE, digital hotplate, stirrer) and heated to a surface temperature of 85°C.
- c) Before the creping aid dried a wet cotton cloth (2" x 8") containing approximately three times its weight of water was applied to the hot panel to cover the surface and rolled down with a 2 kg cylinder.
- d) When the cloth was dry it was peeled off by hand at an angle of 180 degrees. The degree of adhesiveness was noted on a scale from 1 to 5 (1 being very adhesive and 5 being not adhesive at all).

EXAMPLES

<u>PRODUCT</u>	<u>ADHESIVENESS</u>	<u>CHEMICAL CHARACTERISTICS</u>
I	2	Polyamide/EPI wet strength resin
J	3	Polyvinylacetate
K	1	Polyvinylacetate
	(cotton cloth ruptured!)	
L	3	Methacrylic/acrylamide 1:4 Copolymer (MW 18,00)
M	2	Methacrylic/acrylamide 2:1 Copolymer (MW 20,000)

CLAIMS

1. A method of creping a paper which comprises applying to the creping drum prior to the application of the paper web to be creped, a synthetic anionic polymer represented by the following formula:



wherein:-

each R_1 individually represents H or a C_1 to C_8 alkyl group

R_2 represents H, $-\text{CO}_2\text{X}$ or $-\text{CH}_2\text{CO}_2\text{X}$ and

R_3 represents $-\text{CO}_2\text{X}$,

or R_2 and R_3 together represent $-\text{CO}-\text{O}-\text{CO}-$,

R_4 represents $-\text{CONH}_2$ or $-\text{CON}(\text{CH}_3)_2$

R_5 represents a C_1 to C_8 alkyl group

X represents H or NH_4 or an alkali metal

m is an integer from 3 to about 100

x, y, z individually represent the relative mole ratio of each monomer such that x and y are from 1 to 9 and z can be from 0 to 5 with the proviso that when R_1 and R_2 are hydrogen, R_3 is $-\text{CO}_2\text{X}$ and R_4 is $-\text{CONH}_2$, z is not 0.

2. A method according to claim 1 in which a release agent is also applied to the creping drum.



3. A method according to claim 1 or 2 in which the polymer is a copolymer of methacrylic acid with acrylamide and/or methacrylamide, or of acrylic acid with methacrylamide, and, optionally, an alkyl acrylate or alky(meth)acrylate ester or a copolymer of acrylic and/or methacrylic acid with acrylamide and/or methacrylamide and an alkyl acrylate or alkyl(meth)acrylate ester.
4. A method according to claim 3 in which the mol ratio of acid to amide is from 1:5 to 5:1.
5. A method according to any one of the preceding claims in which the polymer has a molecular weight from 5,000 to 25,000, as determined by gel permeation chromatography.
6. A method accordingly to any one of claims 2 to 5 in which the release agent is an imidazoline or a mineral oil defoamer.
7. A method according to claim 1 substantially as described in any one of Examples F, G, H, L and M.

