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"PDS-SIZE"



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The resistance to liquid penetration and diffusion (water, paint, blood, milk, juices, oils, fats, etc.) is of fundamental importance in the utilization and commercialization of many paper types and its products. This process is obtained through internal sizing of the pulp.

Internal sizing consists in the addition of a water repellent material to the pulp during the stage of mass preparing for paper production. The sizing stage has the function to difficult or delay liquid penetration or diffusion in the formed papers. The procedure consists in mix the size to the mass, so the hydrophobic agent involves the cellulose fiber. The internal sizing, beyond to promote paper hydrophobic, gives better retention of charges, fibers and other materials added during mass preparation, as well as promote more stability and resistance to the formed sheet.

In the passed years, the internal sizing process of printing and writing papers in neutral and alkaline conditions has been the most used technology, in Europe and in the United States of America. Lately, the referred technology has been evaluated in Asia and Latin America.

Among the many existing paper types, some of them for its characteristics do not require sizing. Others require a moderate sizing and for some it is necessary an intense sizing. Following, there is a classification of the most well known types of these papers:

(a) Not sized papers: towel paper; tissue paper; filling paper; newspaper; coffee filters and filter papers for laboratory use.

(b) Sizing papers: money paper (highly sized); linerboard; supermarket bags; offset paper; copy paper; basis for coating; rotule paper (highly sized); food packages (highly sized); envelopes.

5 The text bellow describes some products highly used in paper sizing.

 Rosin is a size agent used in internal paper sizing systems since 1804. It consists in a natural product, solid and resinous, insoluble in water, transparent, color amber,
10 extracted from trees of the panacea family. Its formula consists in a complex mixture of organic compounds mutually soluble with 80 to 90 % of resinous acids and 10 to 20 % of neutral material. It is usually divided into two groups: abietics and pimarics. Figure 1 shows the resinous acids
15 formulas actually used in sizing on the rosin basis: 1- Neoabietic acid and 2- Pimaric acid. These are natural surfactants, having in its chain a polar hydrophilic structure and a nonpolar hydrophobic structure. Sizing with rosin has been the main choice on acid conditions.

20 Soap formation with alkali converts the rosin in a form easily soluble in water, allowing its addition to the mass system. The reaction with aluminum salts, forming a compound with positive charge, possibility the adsorption and retention of this compound in the cellulose fiber surface.

25 The sizing emulsions using rosin acid can be cationic or anionic and can have variations and chemical improvements, which aim to facilitate its manipulation, retention in the sheet and better reaction with the aluminum. These variations are:

1) Fortified rosin sizing: the efficiency of the rosin sizing is improved when reacted with the maleic anhydride or with the fumaric acid, resulting in a product much more reactive;

2) Anionic disperse rosin sizing: the resinate particles are dispersed and stabilized by surfactants, starch, polymers or proteins, with cationic characteristics.

The ASA size (Alkenyl Succinic Anhydride) is a patented size and is an anhydride of unsaturated fatty acid. The alkaline sizing agent (ASA) is constituted by a long hydrocarbon chain containing a group reactive to the cellulose. Its origin comes from an isometric olefin derived from the fractioning process of petroleum refining. Its main characteristic is to contain unsaturated reactions along the chain. The product of this olefin reaction with the maleic anhydride is the ASA agent (Alkenyl Succinic Anhydride) used as the active agent in sizes already patented), an oleaginous material (Figure 2). This size must be emulsified at the local and be used right after its fabrication. It also uses the cationic starch as medium for emulsification.

The AKD size (Alkyl Ketene Dimer) is another patented size very much used on internal paper sizing systems. The AKD sizing agent chemical structure can be generalized as showed in Figure 3. The AKD sizing agent is a solid fatty, presenting a 55°C fusion point. Usually it is commercialized in the form of emulsions, with approximately 5 to 15 % of solids content, and a size agent active fraction ranging from 30 to 50% of the solids content. Its production process constitutes basically in the dimerization of the aliphatic acids with chloridric acid, which usually has as main composition the

commercial stearic acid. This size also presents in its constitution, the cationic starch.

The present invention refers to a development of a sizing agent (PDS-SIZE) (Soybean Derived Product - PDS) utilizing
5 Brazilian national product derived from soybean, generating a new substance for paper industries which can be added to the mass system in a paper industry with the objective to delay liquid absorption and diffusion by the paper. The size PDS is developed using an emulsifier, the emulsification is processed
10 in the presence of three substances: soybean derived product, cooked starch and aluminum sulphate.

Nowadays, Brazil imports 100% of products utilized in internal sizing, as well as all its technology. With the aim to revert this situation, it was developed the present
15 invention, so Brazil can have sufficient competitiveness in the international market.

Soybean is a leguminous plant, and its beans give valuable products (oil and flour). The given peculiarity of the fatty oils present in the soybean oil through emulsification it is
20 possible to add them to the cellulose pulp giving hydrophobic to the formed paper sheet. This new product, initially named as Soybean Derived Product - PDS, can be used in acid, neutral or alkaline paper sizing.

The fatty acids of natural occurrence in oils and fats,
25 in general, have a long chain constituted by carbon atoms and hydrogen (hydrocarbon chain) and a terminal group called "carboxyl group", characteristic of the organic acids. These acids differ one from another by the size of the hydrocarbon chain and by the number of double bonds. Fatty acids of

natural occurrence, with few exceptions, contains "pair" number of carbon atoms and present a flat hydrocarbon chain, it is, without ramifications. The fatty acids with "odd" carbon numbers - or ramified chain - are called "uncommon fatty acids". They sustain certain functional groups (-OH, -CO, ...) and can be found in determined plants or in microorganisms. However, they can occur in animal fats, in quantities rarely exceeding 1-2%. Some seeds, certain fruit pulps, and germs of some cereals are the most important source of oils.

"Saturated" fatty acids are the ones that have simple bonds among carbon atoms, each carbon being linked to two hydrogen atoms. On the other hand, "unsaturated" fatty acids have double bonds between the carbon atoms, each carbon being linked only to one hydrogen atom. These different compounds differ basically one from another by the size of the hydrocarbon chain and by the number and position of the double bonds. They are represented generally by the formula $R-COOH$, where R represents any hydrocarbon chain.

However, the register claim for invention patent for PDS sizing agent (PDS-SIZE) has three substances in its constitution as follows:

(1) a mixture of fatty acids extracted from soybean with the following average constitution: Palmitic acid (13%), Stearic acid (5%), Oleic acid (22%), Linoleic acid (50%), Linolenic acid (8% maximum). These substances are extracted from soybean seed by means of brute oil distillation.

(2) Starch: this product is already used in other sizes with the same function.

(3) Aluminum sulphate.

In the formulation of PDS-SIZE, the percentages referent to each substance are: 12,69% of fatty acids, 4,72% of starch, 6,09 % of aluminum sulfate and 76,5% of water. These
5 percentages can vary for more or for less.

The PDS-SIZE fabrication stages are:

(1) Cooking of the starch at 5% of solids (ebullition for 20 minutes with constant mechanical agitation), cooling at ambient temperature;

10 (2) Heating of the fatty acid in steam bath, at 35°C temperature;

(3) Formulation of 160 grams of cooked starch (4,72% of starch and 76,5% of water), 25 grams of fatty acids at 35°C (12,69%) and 12 grams of aluminum sulfate (6,09%). Allocating
15 all the weighted mass in the emulsifier container and operating it at the maximum velocity for 20 minutes promoting the emulsification.

Two great advantages of this product are its biodegradable organic characteristic and its renewable source, since soybean
20 is cultivated in Brazil in large scale.

Table 1:
Structure of main saturated and unsaturated fatty acids present in the oil vegetable.

Saturated Carboxylic Acid	Unsaturated Carboxylic Acid
$\text{CH}_3[\text{CH}_2]_6\text{COOH}$ Caprylic Acid	$\text{CH}_3[\text{CH}_2]_5[\text{CH}_2]_7\text{COOH}$ $\text{HC}=\text{CH}$ Palmitoleic Acid
$\text{CH}_3[\text{CH}_2]_8\text{COOH}$ Capric Acid	$\text{CH}_3[\text{CH}_2]_7[\text{CH}_2]_7\text{COOH}$ $\text{HC}=\text{CH}$ Oleic Acid
$\text{CH}_3[\text{CH}_2]_{10}\text{COOH}$ Lauric Acid	$\text{CH}_3[\text{CH}_2]_4\text{CH}_2[\text{CH}_2]_7\text{COOH}$ $\text{HC}=\text{CH}\text{HC}=\text{CH}$ Linoleic Acid
$\text{CH}_3[\text{CH}_2]_{12}\text{COOH}$ Myristic Acid	$\text{CH}_3[\text{CH}_2]_1[\text{CH}_2]_7\text{COOH}$ $\text{HC}=\text{CH}\text{HC}=\text{CH}\text{HC}=\text{CH}$ Linolenic Acid
$\text{CH}_3[\text{CH}_2]_{14}\text{COOH}$ Palmitic Acid	
$\text{CH}_3[\text{CH}_2]_{16}\text{COOH}$ Stearic Acid	

Table 2: Fattys acids of anyone vegetable oil and fats.

Fat and Oil	Saffron	Cotton	Palm tree	Peanut	Rice	Babassu oil	Buriti	Canola	Coconut	Sesame oil	Germen wheat	Sunflower	Indkia	Linsed	Miscantha	Cocoa butter	Orn	Olive	Palm oil	Soybean
Caproic C:6:0						3-6			5-11											
Caprylic C:8:0						4-7			5-10				12		6					
Capric C:10:0													10		5					
Lauric C:12:0						44-46			45-50				44		44					
Mristic C:14:0	1-2	1-2	1-3		1	15-20			18-20				11		9		1-2	1	1	1
Palmitic C:16:0	5-8	18-25	35-43	17-12	15	6-9	16	4	5-10	6-8	14	7	7	4-6	5	25-30	7-11	5-15	48	6-14
Stearic C:18:0	3-5	1-2	3-5	2-6	2	3-5	1	2	1-4	2-5	4	3,3	3	2-3	2	30-35	3-4	1-4	4	2-7
Araquidic C:20:0				1-3						1				1						
Palmitoleic C:16:1 (9)					1		0,4	0,1	0,4											
Oleic C:18:1 (9)	15-20	17-37	34-56	30-58	45	14-19	79	60	6-8	45-50	20	14	13	13-28	26	35-40	23-25	67-83	38	10-23
Linoleic C:18:2 (9,12)	50-27	44-55	9-11	21-37	36		1	19	1-3	40-45	55	75	2		3	2-4	50-57	7-12	9	50-59
Linolenic C:18:3 (9,12,15)							1	10			7			46-61						4-9
Others	1-2	1-2	1-2	2-3		1-2			1-2	2-3							1-2	1		

CLAIMS

1. "PDS-SIZE", characterized by a constitution of
5 fatty acids extracted directly from the soybean oil
from agriculture.

5 2. "PDS-SIZE", characterized for passing through
an emulsifier the following substances: fatty acids
extracted from soybean, starch and aluminum sulfate.

3. "PDS-SIZE" characterized for also using fatty
acids extracted from another plants presented in Table
10 2, as well as the utilization of isolated fatty acids.