Efficient uses of some types of surfactant products

Utilizări eficiente ale unor tipuri de produşi antistatizanţi

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Abstract

The present work is part of a more complex study referring to chemical substances known under the name of „surfactants” or „tensioactive agents” which can alter the conductivity of fibres, textile materials, etc. in order to diminish some negative fiziological effects on the human body. The use of raw materials, indigenous or imported, refers to the strategy adopted by each firm, concerning their own technology, which should include both organization and management of production processes, and ways of introducing the technical progress with economic efficiency.

Keywords: *surfactant, textile industry, latex, deformer, isoelectric point, technical progress.*

Rezumat

Lucrarea face parte dintr-un studiu complex, referitor la substanţele chimice cunoscute sub denumirea de surfactanţi – agenţi activi de suprafaţă – care pot modifica conductivitatea fibrelor, materialelor textile etc. în scopul diminuării unor efecte fiziologice negative asupra organismului. Utilizarea materiilor prime, indigene sau de import, face trimitere la adaptarea de către fiecare firmă în parte, a unei strategii tehnologice proprii, care va trebui să cuprindă atât organizarea şi conducerea proceselor de producţie, cât şi căile de introducere ale progresului tehnic cu eficienţă economică.

Cuvinte-cheie: *substanţe antistatizante, industrie textilă, latex, antistatizant, punct izoelectric, progres tehnic.*

JEL Classification: O30, O31

The electrostatic load on non-conductive materials, which implies effects of dirt, through the attraction of dust particles from the environment, as well as the production of physiological effects that occur when the human body comes in contact with electrostatic loaded materials –

suggested the idea that, all the processes of prevention and reduction of these effects can be obtained through conductivity improvement techniques of fibers, textile materials and not only.

This change may take place through the action on both the fiber in various stages of manufacture and the manufacturing space environment, by treating with surfactants (Botez, Socolescu & Călin, 2007) – surface acting agents.

Surfactants are usually organic compounds, amphiphilic, having hydrophobic groups – in the terminal part – and hydrophilic groups – at the top.

They are soluble in both organic solvents and water. The term surfactant was first used by Antara Products in 1950.

These substances, depending on their chemical structure, are adsorbed on fibers or latexes and can persist for a long time, or may be removed through washing processes.

Chemical products with antistatic properties are part – as mentioned – of a wide variety of classes that include anionic, cationic, nonionic, amphoteric surface active agents, silicone derivatives etc.

The anti-electrostatic action is supplemented by effects of lubrication, emollient, hydrophilic and emulsifier – properties used in the pharmaceutical industry to prepare creams and lotions, degreasers and cleaning agents for fabrics and surfaces.

Also worth mentioning are the effects of additivation, painting – the tinctorial (Antohi et al., 1992) properties of polymers that increase greatly the intensity of colors, leading to the use of dye in small quantities – or the anti-fogging feature, the disinfection of some medical products, or in cosmetics – hair conditioning after shampoo etc.

Because of their excellent properties, this class of products is, also, recommended in biochemical techniques, such as electrophoresis for the identification of proteins and the investigation of molecular properties of membrane proteins and lipoproteins, in high performance liquid chromatography, in luminescence spectroscopy.

As products with emulsifier character we mention the diamines obtained by the authors (Botez, Călin, Socolescu & Ganciu, 2008), from indigenous raw materials, such as dicarboxylic acids, after their methods of work.

Substances presented emollient and antistatic effects and are non-inflammable, compatible with the fleets applied in the treatments for Revlon and Melana (Crețu et al., 1986) fibres.

Auxiliaries, for the textile industry, leather, electro-insulating varnish and paints industry and the softeners or soap industry, can be obtained using a range of indigenous raw materials, produced by the company S.C. SIN S.C. – “Oleochemical products less toxic and polluting” (Table 1).

Indigenous oleaginous products

Table 1

Raw materials	Application fields
Distilled acids from animal fats, technical	Obtaining emulsions for polymerization of synthetic rubber; Soap industry; Waxes industry and other chemical intermediates.
Distilled acids from vegetable oils (from sunflower oils – AGUFS; from soybean oil – AGUFS)	Obtaining alkyd resins, in the softeners industry; Electro-insulating varnish industry; Manufacture of textile auxiliaries, fatty esters etc.
Fatty acids of tallow (mixture of natural fatty acids saturated and unsaturated)	Manufacture of waxes;
Tehnolin (distilled fatty acids from linseed oil)	Industry of varnishes and paints.
Agurd (mixture of distilled fatty acids, obtained from dehydrated castor oil)	Industry of varnishes and paints.
Trioleina (oleic acid with glycerin)	Auxiliaries in the leather industry – in the form of pigment pastes**.**

Thereby, the use of raw materials, indigenous or imported, refers to the strategy adopted by each firm, concerning their own technology, which should include both organization and management of production processes, and ways of introducing the technical progress.

Generally these compounds with antistatic effect are not toxic, except for small experimental abstractions. For example, in the case of per fluorinated acids production, by transforming in polyfluoroalkyl phosphate surfactants (PAPS) – biodegradable or non-biodegradable – were investigated the pathways of human contamination – because these per fluorinated acids were detected in human blood worldwide, with increased levels in the industrialized areas (D'eon & Mabury, 2007). The contamination is possible through indirect exposure to per fluorinated acids, for example, through ingestion in the treatment of paper packaging etc. „The investigation has been quantified by contaminating some batches of guinea pigs to which were administered variable doses of fluorotelomer alcohol (FTOH), while in contact with the paper packaging. The liver and tissues of the animals tested showed increased levels of PFOA (perfluorooctanoic acid) /PAPS which leads to the conclusion that these compounds migrate into food from paper packaging."

One of the practical uses of surfactants is based on their capacity to adsorb on latexes, discovering thus the possibility of using the „emulsifiers" in obtaining the pigment pastes in the presence of a water dispersion of an ethyl acrylate copolymer, acrylic acid, metylacrylamide, for finishing natural leather. This way, the technology eliminates the pigment pastes based on casein and generally - natural proteins – as dispersion and stabilization agents of pigment particles.

By replacing casein with a surfactant agent, were able to obtain more stable pigment pastes, miscible with water and which imprint the final product – in this case natural leather or substitutes – superior quality properties - "Pigment pastes based on acrylate copolymer for finishing natural leather" (Trişcă-Rusu et al., 1989).

However, the multi-component systems mentioned require the observation and correction of paste's viscosity, by controlling the amount of acrylate copolymer.

The classification of pigment pastes is made according to the type of pigment used: anorganic or organic. It was determined that, the difference between the processes for preparation of pigments paste from the same category, lies in adjusting the viscosity, which is made by adding water up to the optimal value. "Basically it was proven that, regardless of the pigment's color, is obtained a homogeneous paste, with desired luster, with a pigment concentration of approximately twice to the similar pastes based on casein. As well, has been observed that the nature and size of the pigment's particles, affect the quality of produced paste, which should feature fineness, dispersion's stability, covering capacity". (D'eon & Mabury, 2007).

The viscosity index – essential parameter for obtaining the best quality pigment pastes, was studied by several authors (Mahli et al., 2003), taking into account the behavior of surface active agents and their influence on the viscosity of associated (coagulated) solutions – respectively of the dispersed latex in water.

Practically it was used a dialyzed 108 nm monodisperse acrylic latex, stabilized with a surface acid group (accounting for 16% of the total surface) and which were studied 0.25 volume fraction (VF). In the latex the amount of surfactant (for each sample SDS <<Crețu et al. 1986>> and NDE) was controlled, to which were added 0.5 nm jell.

In Table 2 is presented the variation of viscosity index according to the nature and influence of surfactant used and the influence of hydration layers on effective volume fraction.

Relative viscosity of latex with 108 nm 600 nm concentration

Table 2

Adsorbed layer thickness	Effective Volume Fraction	Relative viscosity	Viscosity (Pa.s)
600 nm Latex			
5 nm…………….....	0,26	2,31	0,006
10 nm………………	0,28	2,52	0,006
15 nm……................	0,29	2,64	0,007
20 nm………….......	0,30	2,77	0,007
25 nm……………....	0,31	2,91	0,007
108 nm Latex			
5 nm………………..	0,32	3,05	0,008
10 nm………………	0,39	4,57	0,011
15 nm………………	0,46	7,87	0,019
20 nm………………	0,53	18,15	0,045
25 nm………………	0,60	120,92	0,302

Whatever the mechanism, the synergy of large viscosity increases in nonionic surfactant solutions containing HEURs with large terminal hydrophobes.

As can be seen from the table, when multiple hydrophobes are attached to the terminal positions, the nonionic surfactants dominate over SDS.

Figure 1 presents the variation of surfactant concentration (mM) after adsorption on acrylic latex.

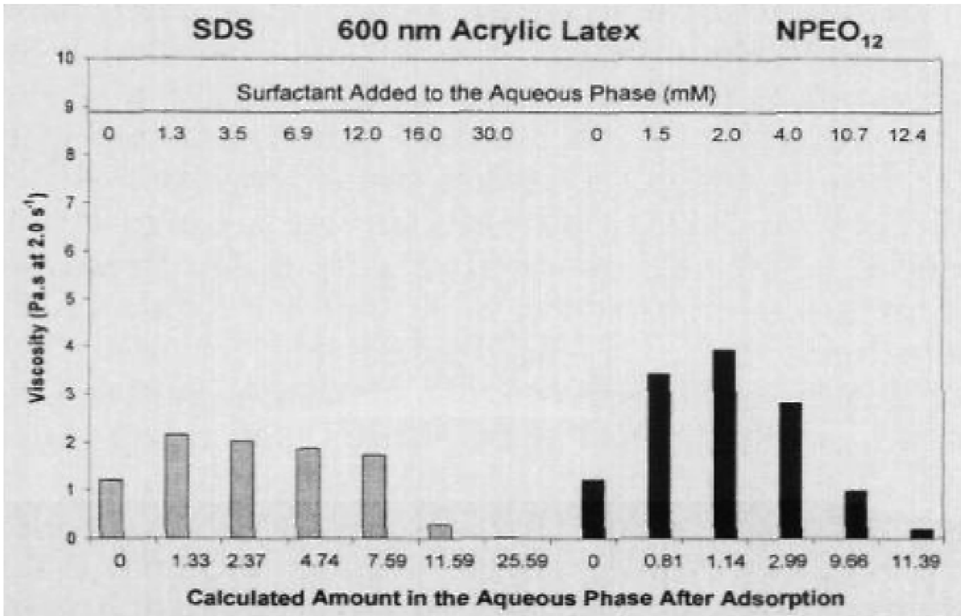

Figure 1. The calculated amount of surfactant (mM) before and after the adsorption on acrylic latex *(gray bars – SDS = surface agents used in biochemistry, black bars - $NPEO_{12}$, mM = millimoles)*

Thereby, at a 108 nm concentration of acrylic latex, and a 0.66 wt% content of HEUR (Poly(oxyetylene) – modify waterproof latex), various quantities of surfactant – $NPEO_{12}$, the viscosity value is low – 25 VF.

In figure 2 is presented the isoelectric point of MMA / MAA (96/4) latex with 0.5 wt% model associative thickener $(C_{18}H_{37}NH - COO)_2(EtO)_{454}$ at pH =9,2. When the concentration of acid or base in a protein solution is adjusted so that the number of COO^- şi NH_3^+ groups of each macromolecule is equal, the isoelectric point is reached. At the isoelectric point the solubility of macromolecules is minimal, and most of them are insolubles. The effects of the electrostatic forces that can influence the viscosity's difference are minimized by the adsorption of an HEUR.

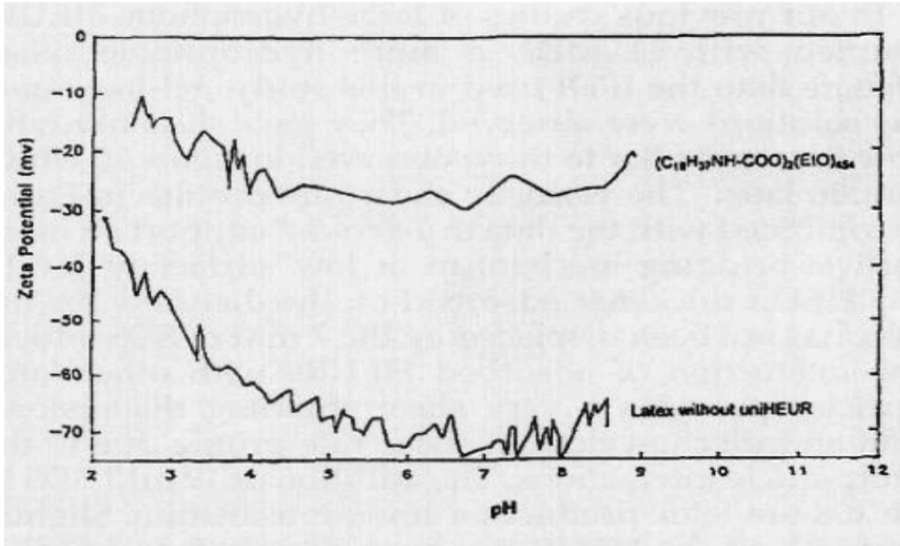

Figure 2. Isoelectric point (IEP) of MMA/MAA (96/4) latex with 0.5 wt% model associative thickener $(C_{18}H_{37}NH - COO)_2(EtO)_{454}$ at pH = 9,2

Regarding the quality and behavior of pigment pastes, this is in term of control and correction of the necessary viscosity up to a value of ~90KU considering the quantity variation of pigment, dialyzed acrylic latex and surfactant.

For obtaining the pigment pastes was studied the influence o three pigments with pure titanium (Ti) mixed with acrylic copolymer (D'eon & Mabury, 2007). The pigment grind composition is easy to keep and has a constant concentration – Table 3.

Pigment grind formulations

Table 3

Formulation for this study		**Standard formulation**	
Component	**Amount (g)**	**Component**	**Amount (g)**
TiO_2 (R-900) Dispersant: oMMA Surfactant: $NPEO_{12}$	149,5 1,94g 0,04g (1,20 mM)	TiO_2 (R-900) Dispersant[a]	149,5 4,5
Dispersant: DIBMA Surfactant: $NP(EO)_{12}$ or Surfactant: SDS	1,79g 0,034g (1,02 mM) 0,129g (1,02 mM)	Surfactant[b]	2,0
Ethylene glycol Water Defoamer Total	10,7 33,0 0,00 195,0	Ethylene glycol Water Defoamer Total	10,7 27,0 2,6 196,3
(a) DIBMA; (b) b-$C_{13}H_{27}(OEt)_9$			

oMMA= polymethacrylic acid; $NPEO_{12}$ = nonfenol – etilen glicol; DIBMA = copolimer dizobutilen şi acid maleic; MMA = metacrilat de metil; VF = factor de viscozitate

And in Figure 3 is shown the variation of thickener for a dialyzed latex with stabilized TiO_2 pigment, needed to achieve ~90KU viscosity

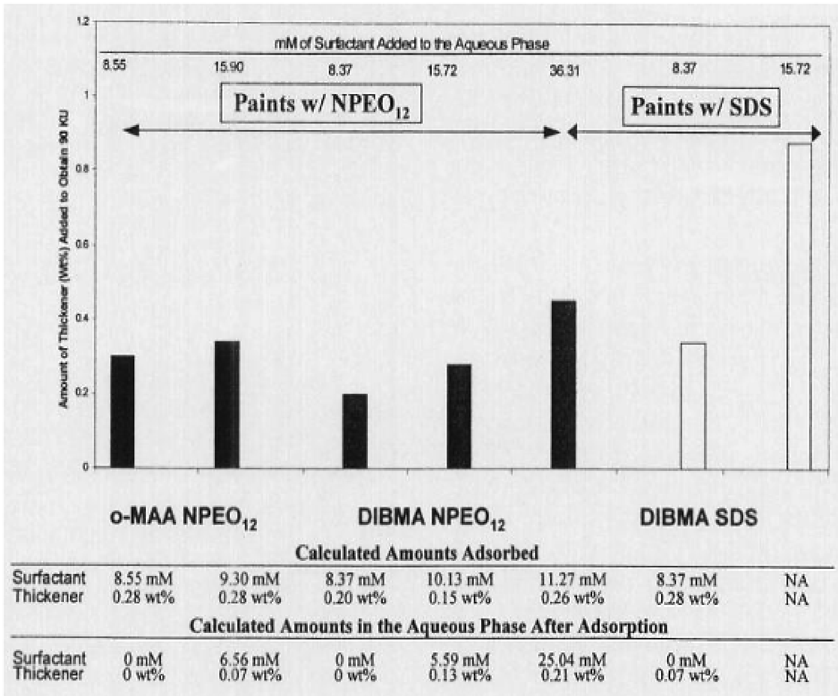

Figure 3. Concentration (wt%)of thickener needed to achieve ~90KU viscosity with 108 nm dialyzed latex and stabilized TiO_2 pigment

In Table 4 are presented the most important physical properties of surfactants considered in this study.

Physical properties of surfactants considered in this study

Table 4

	CMC (10^{-3} M)	Aggregation (N)	Micellar Weight
SDS......................................	8,2	64	18,400
b-$C_{13}H_{27}(OEt)_9$....................	0,12	164	98,000
NP 12 – Nonifenol $(EO)_{12}$...	0,075	175	131,100
NP 40 – Nonifenol $(EO)_{40}$...	0,10	31	60,900
Brij 700 – $C_{18}H_{37}(EO)_{100}$....	0,02	Not available	NA

In conclusion, the brief study presented, seeks to confirm the excellent properties of this class of substances, called "surfactants", surface active agents, which are recommended to be used in multiple technical and economical activity areas. Used in textile industry, in the preparation of fibers, auxiliaries in dyeing processes – pigments pastes – for textile and leather industry – mainly through favorable alteration of the viscosity index etc., these substances play a positive role in increasing the commercial quality and value of many products.

Also, the new usages of surfactants lead to the production of nonpolluting (clean) products, this way allowing the protection of the environment.

This way are set the bases of developing cleaner technologies for a wide range of products intense used in many industrial activities that process raw materials.

Also worth mentioned is that the phenomenon of pollution and the introduction of clean technologies are included within the sphere of technical progress and economic eficiency, which represents the application of science and technology achievements in the economic practice of the 21st century.

References

Antohi, N., Ponoran, I., Tufan, E. & Călin, G. C., (1992), *Materiale plastice*, 29, 1

Botez, F. L., Călin, G. C., Ganciu, G. R. (2008, November 21), *Simpozionul Internațional „Abordări Moderne în Mangementul şi Economia organizației" – Strategii de aprovizionare şi vânzare*, Bucharest

Botez, F. L., Călin, G. C., Socolescu, A., Ganciu, G. R., (2008, May 23-24), ,,Research in the domain of surfactants". In: *Investițiile şi Noua Economie – Lucrările celui de al optulea simpozion internațional „Investițiile şi Relansarea Economică. Vasilescu I., and Luban F. eds*, Bucureşti, Editura ASE, pp. 273-280

Botez, F. L., Socolescu, M., Călin, G. C. (2007, May 25-26), "Diversification of the chemical industry products. Chemical surfactants for textile industry". In: *Proceedings of the Seventh International Symposion. Investment and economic recovery*, Bucureşti, Editura ASE, pp 639-644

Călin, G. C., Ganciu, G. R. (2005), *Inovarea şi progresul tehnic*, Bucharest: Revista de Comerț, 11-12

Crețu, S., Părăuşanu, V., Călin, G. C. și al. (1986), *Industria uşoară*, vol. 34, nr. 6, 274

D'eon, J., Mabury, S. (2007), Production of Perfluorinated Carboxylic Acids (PFCAs) from the Biotransformation of Polyfluoroalkyl Phosphate Surfactants (PAPS): Exploring Routes of Human Contamination, *Environmental Science &Technology*, Easton, vol. 41, Iss 13

Mahli, D., Steffenhagen, M., Lin-lin Xing, Glass, E., (2003), Surfactant behavior and its influence on the viscosity of associative thickeners solutions, thickened latex dispersions, and waterborne latex coatings, *Journal of Coatings Technology, Blue Bell*, vol. 75, Iss 938, JCT

Trişcă-Rusu, A., Brandsch, J., Bălțațeanu, T., (1989), Întreprinderea chimică, *Industria uşoară*, nr. 9