



Auxiliaries for the textile industry and environmental protection

Auxiliari pentru industria textilă și protecția mediului

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Abstract

The textile industry is an industrial field that affects the environment, from the plant growth until the production process. The obtaining of environmental licence for Romanian companies that produce textile products is related to elaboration and implementation of a modern system for an environmental management, that consist in utilization of ecological technologies for finishing, in diminution the water and energy consumption, cleaning of waste waters, reutilization of cleaned waters, sustainable management of wastes. In this study, the surfactant categories used in the textile industry that fulfil the conditions of environment protection, are presented. Some exemplifications were made involving the existing surfactants in Romanian textile industry, obtained from both domestic and external production. Also, some recommendation are suggested regarding the utilization of surfactants manufactured from either vegetal oils or chemical/petrochemical wastes, with similar properties as those from import having decreased prices an that affect as small as possible the environment.

Keywords: *textile industry, surfactant, pollution, environmental protection*

Rezumat

Industria textilă este un domeniu industrial care afectează mediul ambiant, de la creșterea plantelor, la procesul de producție. Obținerea autorizației de mediu pentru societățile comerciale producătoare de textile din România depinde de elaborarea și aplicarea unui sistem modern de management de mediu, care să aibe în vedere utilizarea de tehnologii ecologice de finisare, reducerea consumului de apă, energie, epurarea apelor reziduale, reutilizarea apelor epurate, managementul durabil al deșeurilor. In acest studiu sunt prezentate categoriile de surfactanti utilizate in industria textilă, care îndeplinesc condiții de protecție a mediului. Se fac exemplificări pe surfactanți existenți pe piața din România, obținuți din producția internă și din import, având ca utilizator industria textilă. Se recomandă utilizarea de surfactanți produși din uleiuri vegetale, sau din deșeuri chimice și petrochimice, cu proprietăți similare celor din import, prețuri reduse și care să afecteze cât mai puțin mediul ambiant.

Cuvinte-cheie: *industria textilă, surfactant, poluare, protecția mediului*

JEL Classification: L67, O13, Q56

Introduction

The textile industry is an industrial field having serious problems referring to the environment pollution. In the world the annual production of 2 million solid wastes, 3 million of carbon dioxide as well as 7 million cubic meters of waste waters was recorded (Protectia mediului in Romania, nd). The pollutants proceeded from many sources. Besides the industry, a first pollution source is agriculture field, where immense amounts resources are produced that generally are not entirely recycled. Additionally, the frequent changes of tendencies in the fashion determine a growing production that is useless many times, together with an excessive pollution. The pesticides used for protection of plant cultures destined to textile industry are harmful for fauna, also contaminate other products and reach to the food. Thus, the cotton growing requires 25% of total amount of pesticides used in the world, these chemical substances being recognized as carcinogens (Green shopping, march 2009).

The used chemical substances for dye and discolour textile materials contain chlorine, chrome and other pollutants that affect the environment, being dangerous for the life of farmers, process workers, and also of those who wear the clothes (Ape uzate, nd). Moreover, during the dyeing process of materials huge amounts of water are used which remain concentrated with pollutants and, therefore, require cleaning. As, an example (National Research - Development Institute for Textile and Leather, 2006), some alkaline and coloured waters result from the fibre preparation and textile manufacturing. These waste waters have a value of OBC index (oxygen biological consumption) of 60-1380 mg/L, 30-900 mg/L suspension of solid particles, 5 mg/L nitrogen compounds, 1.5 mg/L phosphorus compounds as well as a raised temperature. The waste waters may also contain free chlorine, sulphides, mineral acids, hydroxides, starch, greases, oils, hydrogen peroxide, heavy metals (zinc, copper). Consequently, the treatment of waters consists in more complex processing such as neutralization, chemical precipitation and conventional biological cleaning.

It is well known that in the textile industry, beside of natural fibers the synthetic fibers are commonly used; these fibers consume the potential exhausting resources of the world regarding oil and natural gas. In this respect, the ecofashion intends both the environment protection and consumers health together with the workers health by improvement of their working conditions. The ecological clothes are made from organic natural textiles, as the cotton cultivated without pesticides or the silk obtained from silk worm grown in organic medium. In France, the ecological products are special labelled indicating the steps within the corresponding plant convert into cloth product and the benefits of using such kind of product. Also, the applied label indicates the toxic indices from product composition in order to eliminate some health risks. Such indices can be, for instance: the formaldehyde content of product that led to irritations, neck ulcerations, oesophagus, stomach, nose, eyes and skin diseases; the content of

heavy metals which lead to serious diseases, dermatitis, destruction of kidneys, anaemia and brittleness of bones; the hexavalent chrome may provoke skin ulcerations, irritations of nose mucous and sometimes the modification of enzyme activity.

Recently, regarding the textile products group the RO-Flowe ecological label was introduced in Romania, which is similar as European label; this is an important measure of National Commission for Awarding the Ecological Label belonging to the Environment Ministry. It is expected from the eco-labelling the increase of opportunities for export, by conformation with international legislation, assurance of human health of consumers, financial savings by optimization of processes and remove the toxic and dangerous substances from the production process.

During a technological process the environment preservation may be accomplished by the following measures (Bunaciu & Durbacă & Roman, 2008; Surfactant, nd): the ecological technologies of finishing able to reduce the values of pollution indices; modern technological solutions for waste water cleaning; diminution of water and energy consumption; reuse of cleaned water; sustainable management of wastes; elaboration and application of a advanced system of environment management by new concepts of environment protection and by obeying the stipulations of European Community Acquis for environment. Since 1990 year, a reason for the removal from activity of many companies involved in textile production (spinning mills, weaving mills, knitwear and ready-made clothes factories) was also related to nonconformity with environment requirements and, hence, to unfulfilled the conditions necessary to obtain the environment licence as a consequence of financial impossibility for refurbishment (Bunaciu & Durbacă & Roman, 2008).

Surfactants based chemical reagents for textile industry

The surfactants (also called surface-active reagents) are chemical compounds that can decrease the surface tension of water even their concentration has low values (Bunaciu & Durbacă & Roman, 2008). The diminution of water surface tension is explained by adsorption at either gas-liquid or liquid-liquid interfaces. Typical molecular structure of a surfactant indicates both hydrophobic and hydrophilic part. The hydrophobic part contains usually a hydrocarbon chain with 8-18 carbon atoms and can be in its nature: aliphatic, aromatic or a mixture of both. The sources are natural greases, oils, petrochemical fractions, synthetic polymers with relatively low molecular weight, or synthetic alcohols with high molecular weight.

According to the nature of hydrophilic groups, surfactants may be classified into: anionic, cationic, non-ionic and amphoteric. Thus, the corresponding groups in anionic surfactants consist in carboxylic groups (as in

soaps, for instance), sulphates, sulphonates or phosphates. The cationic groups are forms proceeded from amines. A non-ionic part is represented by the oxygen from ethers and polyethylene glycol, organic compounds that all are associated with water. In every case, the final hydrophilic group is strongly attracted by water molecules, whereas the attraction of hydrophobic groups is very weak.

The surfactants play an important role in a lot of practical applications, being utilized in various forms (Surfactant, nd): detergents, emulsifiers, dispersants, dyes, adhesives, inks, humectants, waxes, foams, a lot of pesticides (herbicides, insecticides, biocides), some cosmetics, lubricants and others.

Depending on their origin and structure, before weaved, the majority of textile fibres are processed in spinning mills. During the technological processes, in spinning mills and in weaving mills a series of chemical products are utilized as surfactants (separation agents, tensides). A classification takes into account the applied operations, thus:

1. Products in preparation for spinning, which is used in order to prepare and pre-treatment of fibres. These are divided, in turn, into three classes:
 - product training, pre-treatment, ungluing, mercerization;
 - whitening products;
 - softening products.
2. Products in the processes of dyeing and printing, which are divided as follows:
 - products produced by dissolution or dispersion;
 - antifoaming products, antimigration, antifold and protecting fibers;
 - products for equalization and for mordanting;
 - fastening products after washing;
 - products for printing.
3. Final dressing products:
 - products avoiding influence of touch (emollients);
 - hydrophobic starch products, antistatic agents, oleofobe agents, fireproof agents;
 - polymeric dispersions, catalysts, reticulated resins;
 - special products, as antibacterial, antimicrobial, UV absorbers.

The surfactants and the environment

An adequate choosing of the surfactant takes into account the properties, price, its effects on human health (people working in the manufacturing process or consumers of textile products) and the impact on the environment. The properties required in various applications of surfactants can be known from product guides published by various producing companies.

In general, there are followed the properties which lead to a certain effect in the production process, or for consumers. Other issues are related to energy

consumption that must be reduced more, and the mutual influences of various substances in the mixture. In recent years, it is much considered the impact of some products (and hence of surfactant) existing in the remaining water, or products that affect the environment.

Biodegradability of surfactants is one of important properties related to their impact on the environment; the process can take place in two stages:

- primary biodegradation when lowering the foaming properties of surfactants;
- final biodegradation that is complete, up to carbon dioxide and water.

The main factors affecting biodegradation are physical size of the surfactant molecule and the degree of ramification. Knowing surfactant structures can provide which types of molecules are more easily biodegradable and which are harder.

Other properties that make surfactants may become friendly for environment are:

- application by exhaustion;
- degradation of peroxides (for surfactants in combination with enzymes);
- obtaining from plant products that facilitate biodegradability;
- their use at temperatures close to ambient, and so on.

Types of ecological effects of surfactants used in the textile industry in Romania

Romanian textile industry uses a variety of auxiliary substances provided from domestic production and import; for instance, they are purchased from various companies such as Clariant, DAIT-STAR, B-ZEMA, CIBA, ROTA, BASF and others.

In the following we present several types of surfactants produced by the company CLARIANT (Clariant, nd).

1. Produce of enzymatic ungluing:

Bactosol TK contains enzymes based amylase; its effect shows a strong degradation of starch, being applied by exhaustion. *Bactosol FB* contains enzymes amylase and cellulose, used for ungluing ungluing, for special effects, the wearing (Wash and Wear) "type articles on jean, cellulose fiber and mixtures with synthetic fibers. It is stable in water strong acids (optimum pH = 5,0-6,0), optimum temperature being 50-60° C; it is recommended for continuous and discontinuous processes.

2. Enzymatic products for special treatment

Bactosol AP containing enzyme catalase-based liquid that is applied by exhaustion to remove traces of hydrogen peroxide after bleaching. It is applied to a temperature of 20-40° C, pH 6-8.

Bactosol SAP contains enzymes based on selected catalase, which are used for cellulose fibers and their blends, and is stable in the presence of detergents and wetting agents; it decomposes traces of hydrogen peroxide after bleaching, without attacking fiber colors and is presented as organic product.

3. Products for cleaning, cooking, washing

Imerol XN is an ether as recommended polyglycolic posted very effective for all kinds of stains; - used for all types of fiber, alkali-stable at up to 19° Be NaOH; - strong wetting agent; - shall apply by all processes of exhaustion, continue processes.

Sandoclean PCJ - synergistic mixture of alkyl-ethoxylates and fatty alcohols, which are used for all types of fibers and blends them into operations of ungluting, preparation, cooking, washing, bleaching etc.; - it is biodegradable; - it is applied by exhaustion.

Sandoclean JSF - alcoxilat fatty alcohol used to remove traces of mineral oils; - stable in hard water, acid and alkali to 6 ° Be NaOH; - organic biodegradable product.

Sandoclean TiO - fatty alcohol-ether-aryl sulfonate poliglicolic used as universal auxilliary in bleaching with hydrogen peroxide and a cotton mixtures, acting as softening, detergent and stabilizer, with significant economic efficiency; it - is environmentally biodegradable.

Sirrix ATO- glucozidic derivat, is used to ungluting, preventing the formation of oxicelluloze in alkaline environments, items used in processing jeans, partially or totally replacing treatment with pumice, being environmentally biodegradable.

Sirrix CRC - alkyl sulfate salts organic and inorganic - stable alkaline fleets up to 30° Be NaOH; it acts as a wetting agent in reductive alkaline fleets and is applied by exhaustion and continuous process.

4. Products mercerization

Sandoflex A – a solution of sulfur esters of fatty acids: - stable in alkaline fleet to 34° Be NaOH; - effect of high penetration and mercerization; - apply by continuous process.

5. Products for final dressing. Hydrophobic dressings and antistatic fireproof oleofobe

Nuva CSF fluid – a dispersion cationic fluoro-carbon is used for all types of fibers; - it gives very good impermeability to water and oils, with effect permanently; - through exhaustion applies in acid medium.

There is some possibility of summary auxiliarii textile using indigenous raw materials. For example company S.C. SIN SA-made products OLEOCHEMICAL distilled acids from vegetable oils (sunflower oil, soybean oil)

to obtain alkyd resins industry plastifiantilor lakes and electrical, textile auxiliaries production of fatty esters and other chemical intermediates (S.C. SIN S.A., nd).

It is used in the country and produced some of the Romanian companies such as OCTA-CHIM-COLOR, which produces textile auxiliary groups presented in Table 1 (Octachim, nd).

The produced textile auxiliary groups from OCTA-CHIM-COLOR company

Table 1

Name	Action
Altexim	Agent ancient properties of emolierie, good equalization, a colourant, penetration capacity and dispersal
Alvirol	Sequester agent for alkaline-earth salts
Alviron	Painting and auxilliary agents dezarerare for all types of fiber
Lavan	Washing agent for all types of fiber, agent for improving resistance soap painting
Losin	Agent dissolution of fat and deployment wet stain washing and dry cleaning for all types of fiber
Sevalin	Auxilliary boiling and blanching
Seventin	Agents to protect the fibers
Sevofast	Slip agents for all types of fiber
Sevofin	Paraffin emulsions
Sevofix	Agents to improve the final treatment resistances and cellulose fibers Polyacryle
Sevofixan	Auxilliary dimensional setting for the wool
Sevolase	Deglutination agent with enzymes
Sevophob	Agent to oleo-hydrophobization for all types of fiber
Sevoprint	Products for dyeing and printing
Sevosoft	Systems for obtaining special effects finishing
Sevosoftal	Antifold agents for all types of fiber and finishing processes
Softycon	Emollient agents for all types of fiber and textile contextures
Stabilthern	Stabilization agent of fall colors
TC Antistatikum	Antistatic agents, lubricants for spinning
TC Binder	Binders for dyeing and printing with pigments
TC Carrier	Accelerator for dyeing fiber polyesters
TC Dispergator	Universal agents of dispersal
TC Emulgator	Emulsifiers agents for removal of spinning oils gluing
TC Entschaumer	Antifoam agents for all the finishing
TC Fix si Wash	Agents and soap for fixing reactive dyes
TC Fixierer	Agents fixing dyes
TC Maschinenreiniger	Special products for cleaning machines

TC Okostabil	Plugging system for maintaining pH countries Oko-specified standards
TC Puffer	Plugging systems for various processes of finishing
TC Reaktant	Reactant resins for finishing higher cellulose fiber
TC Retard	Retardation for painting poliacrilonitril with cationic dyes
TC Schnellnetzer	Moistening agents very effective for all types of fiber, textile materials and processes
TC Stabil	Permanent finishing agents without formaldehyde for easy finishing
TC Stabilisator	Agents for the stabilization process of the peroxide bleaching
Tecoredukt	Reducing agents
Tecovin	Finishing agents for sewing thread and wet waxing agents

In the current economic context, the trading prices of textile auxiliaries have the following values shown in Table 2.

The trading prices of textile auxiliaries

Table 2

Name	Price (euro/kg)
Bactosol CA	10
Bactosol MTN	8
Bactosol JA	7
Bactosol CD	9
Bactosol PHC	3,5
Sandopan BFN lichid	6
Sandopan DTC pastă	5
Sandopan KD	2
Sandozin NAN	2,3
Nuva TC	11
Nuva FBN	13
Nuva K	10
Nuva CSF	13
Mercerol QW lichid	1,80
Mercerol QWLF lichid	2,50

The value of imports of textile auxiliaries in Romania is of 10-12 million/year, of which the products of the company CLARIANT is two million euro per year.

Conclusions

Textile industry is an industry that affects the environment from plant growth to the production process. Textile products may affect the health of consumers and, after their wear and tear, increased amounts of solid waste result.

Applying a modern system of environmental management consists in the use of ecological technologies of production, reduction of both water and energy consumption, waste water purification, purified water reuse, sustainable management of waste. In the paper, a category of textile auxiliaries – surfactants was presented, which contribute along with other chemical and technological agents to impact on the environment. The surfactants are substances absolutely necessary for textile industry in various technological operations, since they facilitate processes and enhance quality and resistance of textile products. In Romania annually are imported large amounts of textile auxiliaries, including the surfactants with good technological properties; among them, some act at relatively low temperatures, some are biodegradable, others destroy peroxides, so being more friendly to the environment. A part of imported textile auxiliaries can be manufactured into the country using indigenous raw materials such as fatty acids, distilled from vegetable oils. In this way some raw materials in Romania may be used, such as a series of chemical or petrochemical wastes from industry, achieving the finished product type surfactants with similar characteristics to those of imports, but cheaper, while reducing environmental pollution.

References

- Protecția mediului în România (nd). *Protecția mediului în România. Produse ecologice*. Retrieved from <http://www.antipoluare.wordpress.com/romania/produse-ecologice>
- Green shopping (march 2009). *Green shopping/ știri din ecologie, dezvoltări sustenabile și protecția mediului/green report*. Retrieved from <http://www.green-report.ro/revista/green-shopping>
- Ape uzate (nd). *Capitolul 2. Ape uzate*. Retrieved from <http://www.hydrop.pub.ro/pu2.pdf>
- National Research – Development Institute for Textile and Leather (2006). *Annual Report*, pp. 107-129
- Bunaciu, M. C., Durbacă, N. & Roman, M. (2008). Aplicarea celor mai bune tehnici europene (BREF/BAT) din domeniul industriei textile pentru îmbunătățirea performanțelor de mediu ale operatorilor industriali. *Buletinul AGIR*, Nr.4, octombrie-decembrie, pp. 80-84
- Surfactant (nd). *Surfactant*. Retrieved from <http://www.en.wikipedia.org/wiki/Surfactant>
- Clariant (nd). *Ghid de produse chimice auxiliare pentru textile*. Clariant (Switzerland)
- S.C. SIN S.A. (nd). *S.C. SIN S.A. – Oleochemical Products*. Retrieved from http://www.sin-sa.ro/eng_oleo_prod.html
- Octachim (nd). *Octachim Trading S.R.L. coloranti, auxiliari chimici pentru industria textila*. Retrieved from <http://www.bizoo.ro/firma/octachimcolor>