



LIFE Project Number
LIFE10 ENV/IT/000364

Progress Report
Covering the project activities from 01/01/2012 to 31/05/2013

Reporting Date
31/05/2013

LIFE+ PROJECT NAME or Acronym
ECOFATTING

Data Project

Project location	Italia – Regione Toscana; Regione Friuli Venezia Giulia; Regione Emilia Romagna; Spagna
Project start date:	01/01/2012
Project end date:	31/12/2013
Total budget	€ 1.598.700
EC contribution:	€ 761.427
(%) of eligible costs	47.63 %

Data Beneficiary

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2. List of abbreviations

SCP Sulpho Chloro Paraffin
CP Chloro Paraffin
CL Chrome Tanned Leather
GSA Gelatin Sigma type A
GSB Gelatin Sigma type B
CMS chloro Methyl Stearate
SCMS solfochloro methyl stearate
FA fatty acids
FAME fatty acid methyl ester
Cl-FAME chlorurated fatty acid methyl ester
SCL-FAME solfochlorurated fatty acid methyl ester
MeOH methanol
IPA isopropylic alcohol
PEG poly ethylene glycol
TGA Thermo Gravimetric Analysis
DTG Differential Thermo Gravimetry
FTIR Fourier Trasform Infrared Sepctroscopy
COD Chemical Oxygen Demand
BOD Biological Oxygen Demand
VOC Volatile Organic Compounds

3. Executive summary

This report represents the activities carried out under the project LIFE+ “Environmentally friendly natural products instead of chloroparaffines in the fatting phase of the tanning cycle - ECOFATTING“ (LIFE10 ENV/IT/000364) over the period between 01/01/2012 and 31/05/2013.

The present project aims at demonstrating the use of an innovative technology for the fatting phase of the leather tanning process, with the goal of producing new or existing products with a significantly higher eco-sustainability profile. The specific technical goal of the project consists in the demonstration of use of a new category of products of natural origin, capable of substituting chlorosulfonated currently used in the fatting phases during the leather tanning cycle.

3.1 General progress.

ECOFATTING project started and is going on as foreseen, and no particular problems have emerged. All actions are progressing as planned. The following actions have been completed: the study of the different fatliquoring agents currently used in the EU tanneries (action 1); the study of the environmental impact of fatliquoring agents currently used (action 2); the demonstration and evaluation of natural products of four esterified vegetable fatty acid derivatives, as substitutes for chloroparaffines (action 3); the environmental demonstration of natural products at laboratory level (action 4); demonstration of fatting process at a semi-industrial level by using natural products (action 5).

Table 1 includes the progress achieved in the project tasks from the beginning (January 1st, 2012) until May 31st 2013.

Table 1. Progress from January 1st, 2012 to May 31st 2013.

Action number	Action description	% Finished
1	Study on the different fatliquoring agents currently used in the EU tanneries	100
2	Study on the fatliquoring agents environmental impact	100
3	Natural products demonstration and evaluation	100
4	Environmental demonstration of natural products at laboratory level	100
5	Fatting at a semi-industrial level by using natural products	90
6	Environmental demonstration of natural products fatting at a pre-industrial level	60
7	Environmental demonstration of hides fatted with natural products	40
8	Study of the demonstration about the environmental benefits from the natural products fatting process	20
9	Quality assessment of leather products production	20
10	Demonstration of technical-economic viability	0
11	Natural products fatting manual	0
12	Leather sample books of hides fatted with natural products	0
13	Material preparation for workshops	70
14	Diffusion material preparation	70

15	Training course for Italian tanneries	30
16	Training course for Spanish tanneries	30
17	Demonstration workshop in Italy	0
18	Demonstration workshop in Spain	0
19	International fairs and other events	70
20	Digital supports for international diffusion	10
21	International diffusion and dissemination	70
22	After-LIFE Communication Plan	0
23	Project management by ICCOMCNR	70
24	Monitoring	70
25	Audit	0

Among the actions started, dissemination activities are fundamental in order to show the role of Life+ projects, in general, and the importance of ECOFATTING project, in particular, to people working in the field of leather tanning as well as to final users. ECOFATTING has been presented in 16 events, in two TV interviews, in 10 newspaper articles, web site, during conferences as posters, abstracts 400 brochures and 400 gadgets.

A formal management structure has been also established and a monitoring protocol which defines duties and rules for the internal exchange of documents has been edited.

3.2 Assessment as to whether the project objectives and work plan are still viable.

The project aims, objectives and work plan foreseen are still valid according to those indicated in the proposal description.

The demonstration of the importance of the replacement of chloroparaffines in the fatting phase of the tanning cycle with no toxic, eco-sustainable natural products, the actions proposed to get this goal and the timing of the project, as well as the project milestones, developed up today are not changed and are still viable.

The following activities are in progress, just as scheduled in the project baseline.

The activities carried out in the first 17 month of the project show that the project objectives are still viable. First, the evaluation of production, use, effectiveness and regulation of different chloroparaffins and chlorosulfonated paraffins and potential natural substitutes were identified. The product-substrate interactions were studied by FTIR, TGA and modeling studies because these techniques revealed the best approach to study matrix-active interaction phenomena (see Section 5 and Deliverables). The fatliquoring agents environmental impact was completed. Natural compounds suitable for the substitution of chloroparaffins and chlorosulfonated paraffins were identified, prepared, analysed and characterized. Their interaction with skin proteins was investigated in depth. The demonstration and environmental evaluation of natural products at laboratory level and the application of fatting at a semi-industrial level by using natural products is almost complete. The production of leather articles (wallet, bags, shoes) started for demonstration purposes. These articles will be presented in the next meetings, courses conferences. Many dissemination activities were already performed (detailed in the specific Annex of Dissemination activities).

The ECOFATTING project objective “environmentally friendly natural products instead of chloroparaffines in the fatting phase of the tanning cycle” as well as the project work plan is still viable and it is confirmed.

The number of beneficiaries is small (5) and there is harmony and good coordination between them and their activities. There is enthusiasm for the results obtained and a positive, optimistic idea that natural compounds developed in ECOFATTING will replace chloroparaffins and chlorosulfonated paraffins once such compounds will be not commercially available. Thus ECOFATTING is giving a great opportunity to demonstrate and exploit these new compounds. An intense activity of networking with PODEBA project (LIFE10 ENV/IT/000365), related to the bathing phase of tanning cycle, is also in progress in order to demonstrate and exploit a sustainable, completely “green” tanning cycle.

3.3 Problems encountered.

To date, no particular problems or difficulties have emerged in the development of the project. All beneficiaries have the technical equipment, the infrastructures and the know-how to move forward on the foreseen project actions. Small changes devoted to improve the project procedures and to agree the EC requirements indicated in the report of the first monitoring visit were already defined in the Inception Report and acknowledged by the EC. Some of these changes related to project activities and documents of the project period defined from the Inception Report to this Progress Report are listed below:

- Number and collocation of Coordination meetings.
Actual project includes a kick off meeting (KOM) and 3 coordination meeting among the beneficiaries. In order to improve the coordination among partner in the 24 month project, the consortium defined the following new schedule of the project coordination meetings:
 - 1st KOM in S. Croce sull'Arno (PI) in the premises of Colortex on 18th of January 2012
 - 2nd Coordination meeting in Pisa in the premises of ICCOMCNR on 18th of June 2012
 - 3rd Coordination meeting in Torviscosa (UD) in the premises of SERICHIM on 22nd of January 2013
 - 4th Coordination meeting in Elda in the premises of INESCOP on 13th of June 2013
- A small variation of original budget (€9.700,00 which is < 10% of the total budget) was applied by ICCOMCNR from “consumables” to “personnel” in order to enroll in the ECOFATTING team for six months (from September 1st 2012 to February 28th 2013) a young scientist (Dr Valentina Della Porta). This was justified by the need of complete the physico-chemical characterization of natural products and the study of their interactions with leather components in order to reach effectively and faster the project objectives. A lower budget for “consumable” did not affect at all the project results.
- In order to perform all the laboratory analysis and perform in more detail the natural products selection and analysis, Serichim has covered some unforeseen technical consultancy costs using part of the costs allocated for external assistance for dissemination without decreasing the effort, activities and resources for dissemination actions.
- As agreed with the project partners and with the prior consent from the European Commission, INESCOP attended the 18th Congress of the Latin American Federation of Leather Technologists and Chemists, FLAQTIC 2012, which took place from 9th to 11th October 2012 in Montevideo (Uruguay). The main objectives of this congress were the continuous improvement of tanning processes, the development of innovative products and the transfer of information between research centres and industries. The Latin American leather industry accounts for 20% of worldwide leather production; therefore, the participation of INESCOP in this congress was a great opportunity to disseminate the LIFE ECOFATTING project to the large audience from Argentina, Brazil, Colombia, Peru and Uruguay. For this purpose, INESCOP presented a paper on “European environmental projects on tanned leather”, which presented the results of the LIFE ECOFFATING project, “Environmentally friendly natural products instead of chloroparaffins in the fatting phase of the tanning cycle”.

- Deliverable of action 1 and 2 was moved to M12, i.e. at the end of action 2 in order to have a complete, exploitable sight of the results. The following table defines the new deadlines for the Deliverables production.

DELIVERABLE PRODUCTS OF THE PROJECT

Name of the Deliverable	Code of the associated action	Deadline	New Deadline
Fat agents	Action 1-2	6 months	12 months
Natural products	Action 3	15 months	15 months
Laboratory level	Action 4	15 months	15 months
Semi-industrial level	Action 5	18 months	18 months
Pre-industrial level	Action 6	21 months	21 months
Environmental demonstration	Action 7-8	24 months	24 months
Study of technical-economic viability	Action 10	24 months	24 months
Notice boards	Action 14	3 months	3 months
Videos	Action 20	24 months	24 months
Articles and press releases	Action 14, 21	24 months	24 months
Dissemination materials	Action 13-22	24 months	24 months
Layman report	Action 20	24 months	24 months
Web site of the project	Action 21	3 months	3 months
After-LIFE Communication Plan	Action 23	24 months	24 months
Audit report	Action 25	24 months	24 months

- The description of all deliverables labelled as “dissemination material” (Actions 13 to 21) has been performed detailing the type of product, as defined in the following table.

DISSEMINATION PRODUCTS

Number of the Action	Name of the Action	Deadline	Expected results	Results at month 15
Action 13	Material preparation for workshops	24 months	Logo definition 1 banner 1000 brochures 1000 gadgets 1 roll up 1 project presentation	Logo definition 2 banner 400 brochures 400 eco bags as gadgets 2 roll up 3 project presentations
Action 14	Diffusion material preparation	24 months	10 notice boards 20 press articles 3 TV interviews	12 notice boards displayed in partners public places 2 TV interviews 10 press articles
Action 15	Training course for Italian tanneries	24 months	25-50 technicians from tanneries trained in natural products fattening phase	-
Action 16	Training course for Spanish tanneries	24 months	25-50 technicians from tanneries trained in natural products fattening phase	-
Action 17	Demonstration	24 months	25-50 Business people	-

	workshop in Italy		from tanneries and leather companies informed.	
Action 18	Demonstration workshop in Spain	24 months	25-50 Business people from tanneries and leather companies informed.	-
Action 19	International fairs and other events	24 months	Participation at 20 events	Participation at 16 events
Action 20	Digital supports for international diffusion	24 months	100 copies of 1 project video in English, Italian and Spanish	-
Action 21	International diffusion and dissemination	24 months	Project web site Clusters with 10 projects 10 posters	Project web site Clusters with 11 projects 5 posters

4. Administrative part

4.1. Description of project management

At all times, the ECOFATTING project has benefited from close collaboration between all partners and has maintained close contact with all through different media: emails, telephone, meetings, etc.

The management of the project is carried out in compliance with what was established in the proposal approved by the European Commission, with all partners acting in compliance with the Common Provisions and the Partnership Agreement.

Partners have carried out different meetings in order to organize, coordinate and develop the project. The coordination meetings held during these first seventeen months of the project were:

- Kick-off meeting, 18th January 2012, at the beneficiary Colortex premises in Santa Croce sull'Arno (PI) - Italy.
- Progress and Coordination 6 month meeting, 22nd June 2012, at the coordinator ICCOM premises in Pisa – Italy.
- Progress and Coordination 12 month meeting, 24th January 2013, at the beneficiary Serichim premises in Torviscosa (UD) - Italy

Monitoring meetings with LIFE's External Assistance Team:

- LIFE beneficiaries Progress and Coordination 6 month meeting, 22nd June 2012: Mr. Ludovico Susani.

In addition many meetings between some partners were organised in order to plan and monitor the project technical activities.

Additionally, each month a report is submitted to the monitor of LIFE's External Assistance Team, which carries out the follow-up of the ECOFATTING project.

4.2. Organigramme of the project team and the project management structure

The project management structure is very simple as only 5 beneficiaries are involved plus the EC and the LIFE external team:

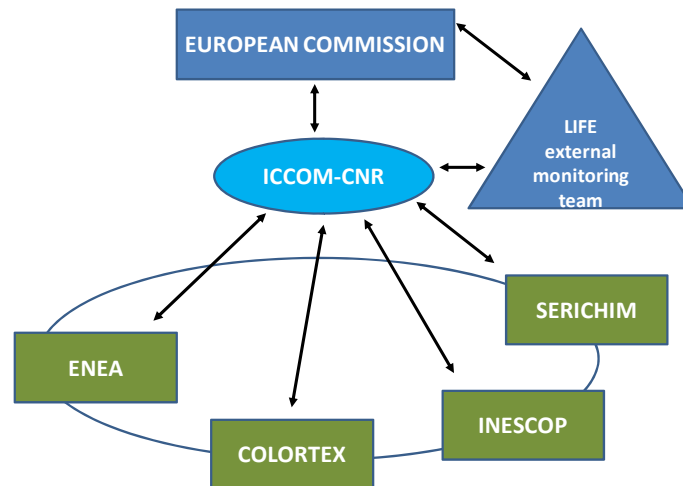


Figure 1. ECOFATTING management structure.

In particular the ECOFATTING beneficiaries defined the following two management structures:

- **Technical Committee:**
 - ICCOMCNR: Dr Emilia Bramanti
 - ENEA: Eng. Alice Dall'Ara
 - COLORTEX: Dr. Antonuccio Cepparone
 - INESCOP: Dr. Mercedes Roig
 - SERICHIM: Ing. Paolo Ferrario
- **Administrative Committee:**
 - ICCOMCNR: Sig.ra Manuela Cempini
 - ENEA: Eng. Ferdinando Frenquellucci
 - COLORTEX: Dr. Sabrina Vastola
 - INESCOP: Dr. Julio Gutierrez
 - SERICHIM: Dr. Giuseppina Vassallo

4.3. Reports delivered and extension

From the start of the project, the ECOFATTING partnership has delivered the following report:

- Inception Report delivered on 30/09/2012 (month 9 of the project)

No extension of the project duration is needed or envisioned.

5. Technical part

Current tanning and fatting technology utilize well established multi-step processes characterized by:

-High percentage of humid process phases, responsible of a heavy environmental impact. Currently, all alternative technologies result in lower product quality.

-Significant use of hazardous substance in tanning such as formaldehyde and various monomers which eventually end up in wastewaters, and traces of which can also be found in the finished product.

-Fatting products are generally hardly biodegradable, and they are only partially absorbed by derma during drum tanning. The non-absorbed product represents both an economic loss and an environmental threat because of the high COD and BOD in wastewaters.

-Use of formulations containing VOC (volatile organic compounds) or generating bioaccumulable and persistent.

-An empirical and non-optimized approach to the preparation of formulations for the various process phases, resulting in slow, not efficient processes with a lot of dangerous air and water emissions.

-Low eco-sustainability due to difficulties in recycling and disposal of semifinished or finished products containing toxic metals.

Leather fatting phase is an operation which is traditionally carried out in tanneries to add flexibility to the leather after tanning and dyeing. Fatliquoring products make up a large part of the reagents used in leather tanning, representing approximately 24% of all the products used in the industrial process. For this reason, fatliquoring agents are one of the most important components of tanned leather, varying between 5-20% of the dry weight of the leather.

ECOFATTING project aims to bring innovation to a specific phase in the fatting process, by developing the use of new natural products, new and more effective formulations, new technological platforms, in order to reduce the environmental impact of tanneries.

5.1. Actions

5.1.1. Action 1. Study on the different fatliquoring agents currently used in the EU tanneries

Action 1 started on 01-01-2012 as scheduled in the project and it has been completed on 30-09-2012. This first activity has covered the study of the existing market scenario for the above mentioned products and this in order to choose the most representative existing fatliquoring agents among the different kind of chloro and chlorosulphonated paraffins. Moreover the review was intended to assess the marked size, in order to verify how new uses of selected raw materials can influence their market structure.

Several quite specialized products resulted to be present on the market, tailored to satisfy very specific requirements. In this population some leading representatives had to be selected. Following discussion with COLORTEX and based on their industrial knowledge a chlorinated paraffin with a 44% chlorine content (corresponding to commercially available CLOPARIN 44F, quantity: 2,00 kg - March 2012; chlorine content % m/m 44,5-46,5, chain length C14-C17, named CP44) and a sulphochlorinated paraffin with a 30 % chlorine and a 3 % sulfur content (corresponding to commercially available CHLOPARTEN Z, quantity: 2,00 kg - March 2012, chlorine content % m/m 29-31, named SCP) were selected as the most effective and diffused fatliquoring agents sold on the market and therefore to be assumed as performance benchmark for the replacement products that should be considered (for details see ANNEX of Deliverables). A third compound, a chlorinated paraffin (CLOPARIN 30F (Quantity: 2,00 kg - March 2012; chlorine content % m/m 30, chain length C18), named CP30, with a lower content of chlorine and a different chain length was selected, sent to ICCOM CNR and characterized in order to better understand the mechanism of interaction with leather components by FTIR, TGA and GC-MS by ICCOM-CNR, SERICHIM and ENEA.

Study of the interaction of CP30, CP44 and SCP with leather components.

The study of the interaction of CP30, CP44 and SCP with leather components was performed by ICCOMCNR and ENEA following different approaches: i) FTIR spectroscopic analysis; ii) thermogravimetric analysis (TGA); iii) modelling computational study. All details related to this part are reported in the Inception Report, in the technical annex to the Inception Report and in the current Annex of Deliverables.

Theoretical investigation of the interactions between Collagen Microfibrils and SCP. Preliminary results.

All solvent species are found in the first solvation shell around the bundles where they are in direct contact with the protein residues. The bundles inflate due to water activity but the fibril

conformation is maintained due to the presence of the cross-linking agents. Water molecules surround the bundles but are also found between the helices. SCP molecules are located prevalently between the CMSs (Figure 3) and in the terminus regions of the chains and their oxygen atoms interact with the amine groups of ARG and GLN residues.

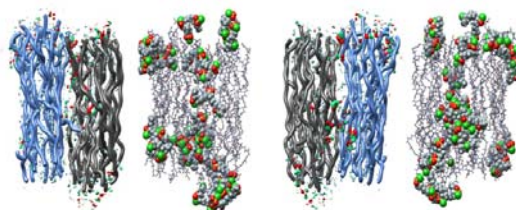


Figure 3. Model of collagen/SCP interaction.

The main output of this action was the evidence of the formation of a chemical bond between reactive sulphochloride groups and basic groups existing on collagen.

In conclusion, all these results showed that not covalent bonds, which include electrostatic interactions (e.g. ionic bonds between Asp⁻ and Lys⁺ and hydrogen bonds), hydrophobic interactions and Van der Waals forces are involved in the interactions of SCP as well as CPs more than expected. Higher content of Cl groups in CPs favorite these interaction. Sulfonamide covalent bond between –SO₂-Cl group of SCP and NH₂- group of, Arg and Gln were also observed in several conditions and are fundamental for protein stabilization. From simulation studies we found that SCP molecules are located prevalently between the CMSs and in the terminus regions of the chains and their oxygen atoms interact with the amine groups of ARG and GLN residues.

The results of this study allowed us also to select acyl chloride group as the chemical functional group that could give the same performance of sulphochlorine group in leather application. Acyl chlorides and chlorinated acyl chlorides can be derived from fatty acids, which are the main oleochemical raw materials.

All the technical issues related to Action 1 are analyzed and defined in detail in the Annex of Deliverables.

As scheduled, this action has been completed by 100%.

5.1.2. Action 2 Study on the fatliquoring agents environmental impact

During the first 9 project months, the LIFE ECOFATTING project, the fatliquoring product families that are most widely used by European tanneries were assessed by INESCOP from the point of view of their environmental performance, setting the parameters to be analysed, as much in fatliquoring products and the wastewater produced in the fatliquoring stage, as in the leather obtained (physical, chemical and organoleptic parameters).

The results obtained will be used as a standard against which the improvement of the environmental impact of the natural fats developed will be compared. For this, the fatliquoring product families to be assessed were firstly selected, as shown in Table ?.

Table 1. Fatliquoring product families evaluated

1	Sulphated olein	6	Sulphated ester
2	Sulphonated olein	7	Phosphoric ester
3	Sulphited olein	8	Sulphochlorinated paraffin
4	Sulphited fish oil	9	Synthetic oils
5	Sulphated lecithin	10	Fatliquoring polymer

Then, the laboratory, semi-industrial and pre-industrial scale leather fatliquoring tests were conducted at INESCOP-U.T. Vall d'Uixó facilities using the selected products. These tests

were carried out on wet-blue cattle hides that had been prepared for the fatliquoring operation by means of a standard process of neutralisation, retanning and dyeing.

The laboratory-scale tests were carried out in pilot drums using 1 sq. foot pieces of leather prepared for fatliquoring. Subsequently, semi-industrial scale tests were conducted on whole hides and finally pre-industrial scale test were conducted on several whole hides in a pre-industrial drum (Figure 4).



Figure 4. Laboratory, semi-industrial and pre-industrial scale fatliquoring tests (INESCOP-UT Vall d'Uixó facilities)

The fatliquoring process performed on neutralised, retanned and dyed leather is shown in Table 2:

Table 2. Working procedure for leather fatliquoring

PRODUCT/PROCESS	% by wet-blue weight
Water (45-50 °C)	500 %
Fatliquoring product	8 % (*)
Rotate for 90 min	
Formic acid (1:10 dilution)	3%
Rotate for 20 min	
Wash, drain drum, take bath sample and remove leather Air dry	

*) In commercial products, greases are mixed with water or emulsifiers with an active ingredient concentration of 65-80%. For this reason, the percentage of the commercial product added is recalculated for each fatliquoring product so as to ensure the addition of the same amount of grease to all leathers.

Once this operation was completed, a sample of the waste fatliquoring bath and a sample of one of the obtained leathers were taken for the determination of the selected physical parameters. Concerning the appearance of the leather samples obtained, in all cases the assessed fatliquoring products conferred adequate softness, fullness and flexibility on the leather. Some differences in shade were observed, which were not considered significant.



Figure 5. Appearance of the cattle leather obtained in laboratory-scale tests.

The environmental impact of the wastewater of the different fatliquoring product families assessed was carried out through the characterisation of the waste fatliquoring baths. The most significant parameters were assessed in accordance with international standards. Table 3 shows the results obtained for the different fatliquoring product families studied (semi-industrial scale tests), as well as the average reference values to facilitate the comparison of results:

Table 3. Characterisation of bovine leather fatliquoring baths (reference fatliquoring baths / semi-industrial scale tests)

	Reference	pH	Conductivity (µs/cm)	COD (mg O ₂ /l)	BOD ₅ (mg O ₂ /l)	Biodegradability (BOD ₅ / COD)
1	Sulphated olein	3.9	3,000	13,800	5,106	0.37
2	Sulphonated olein	3.9	3,000	15,000	8,850	0.59
3	Sulphited olein	3.7	1,900	17,800	8,366	0.47
4	Sulphited fish oil	3.8	2,100	18,300	8,052	0.44
5	Sulphated lecithin	3.8	2,200	17,400	6,960	0.40
6	Sulphated ester	3.5	2,500	15,900	7,632	0.48
7	Phosphoric ester	3.6	2,100	14,700	3,087	0.21
8	Sulphochlorinated paraffin	3.9	5,000	12,700	4,858	0.36
9	Synthetic oils	3.7	2,900	12,900	5,418	0.42
10	Fatliquoring polymer	3.8	2,800	15,100	2,567	0.17
Average reference values		3.8	2,750	15,360	6,089.6	0.39

As to residual bath characterisation, it was noted that the polluting load of all baths was quite similar, in such a way that none of the assessed families of products stood out for a lower environmental impact.

All the technical issues related to Action 2 are analyzed and defined in detail in the Annex of Deliverables. As scheduled, this action has been completed by 100%.

5.1.3. Action 3 Natural products demonstration and evaluation

Activity 3.1: Lab-scale screening of molecules or molecule alternative to chloroparaffins or chlorosulphonated paraffins

This action started on March 2012 and it was completed in March 2013 by Serichim.

As reported in Action 1, chlorinated and sulphochlorinated paraffines are members of a wide population of products, characterized by structural and physical properties. In order to demonstrate that they can be substituted, it was necessary to verify that it is possible to cover similar ranges of the relevant characteristics starting by renewable raw materials. As significant properties the following ones were identified: (i) total chlorine content, (ii) active chlorine content, (iii) viscosity as a function of temperature, (iv) density as a function of literature.

A wide number of small scale samples of chloroparaffins and of chlorinated fatty acid methyl esters were prepared and characterised for the selected properties. A mathematical model was developed, able to predict physical properties as a function of carbon chain length, both for paraffins (reference materials) and esters (new replacing materials). It was assessed that it is possible to cover the same ranges of properties (for details see Annex of Deliverables).

As it was said before, possible substitutes for chlorosulphonated paraffins were identified, and have to be prepared in order to complete this Action.

In this action the plan is to synthesized and evaluated four esterified vegetable fatty acid derivatives as substitute of chlorinated paraffins and solfochlorinated paraffin:

- Methyl stearate (chlorinated and solfochlorinated, CMS and SCMS, respectively)
- Methy Esters of palm oil acids (Palmkernel oil) (chlorinated and solfochlorinated, Cl-FAME and SCI-FAME)

We actually prepared and tested also other products (fatty acid mixture and fatty acids methyl esters) in addition to the planned ones with the aim of collecting more information on their interaction with protein substrate and get further insight their mechanism of interaction with leather proteins. CMS was produced with 4 different Cl percentages in order to evidence the role of chloride content. Esterified vegetable fatty acid derivatives were synthesized and evaluated to the kilo-lab scale as substitutes for chloroparaffins.

Selection criteria were based on the carbon chain length C14 – C17 and introducing the same chlorine and sulphur content as in benchmark products Chloparin 44F and Chloparten Z. The selected products under investigation were:

- CHLORINATED METHYL STEARATE (Lot: 120712 Amount: 2,00 kg- July 2012) 34,4% Chlorine, corresponding an approximate average number of 3 Cl/molecule (CMS34).
- CHLORINATED METHYL STEARATE (Lot.: 120710D Amount: 0,20 kg-July 2012) 37.9/ Chlorine, corresponding an approximate average number of 3.2 Cl/molecule (CMS38).
- CHLORINATED METHYL STEARATE (Lot.: 120710B Amount: 0,20 kg- July 2012) 21.3% Chlorine, corresponding an approximate average number of 1.8 Cl/molecule (CMS21).
- CHLORINATED METHYL STEARATE (Amount: 0,20 kg- September 2012) 44% Chlorine (CMS44).
- METHYL STEARATE SULFO CHLORINATED (Lot.: 120925 Amount: 1,5 kg- September 2012), corresponding an approximate average number of 1.8 Cl/molecule (SCMS), with sulfur content comparable with Clparten Z10S.
- CHLORINATED PALMKERNEL OIL FAME (Lot 130116, 47,5 % m/m Chlorine content).
- SULFO CHLORINATED PALMKERNEL OIL FAME (Lot 130404, 38,0 % m/m Chlorine content 8,6% m/m sulfur content)
- SULFO CHLORINATED PALMKERNEL OIL FAME (Lot 130118, 24.1 % m/m Chlorine content 8,6% m/m sulfur content-1,5 Kg)

Investigation on natural products substitutes of chloroparaffins: chlorinated methyl stearate (CMS), Cl-FAME, FAME, Cl-FA, Chlorinated Palmkernel Oil FAME.

Chlorinated methyl stearate (CMS) is the chlorinated species of methyl stearate ($\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-COO-CH}_3$). These compounds have been tested with different percentage of chlorine functionalities and analyses by FTIR in order to study if a specific Cl concentration gives an optimal interaction with the substrate. This action has been developed from month 3 to month 15 of the project development.

FTIR spectra show a correlation between Cl content determined by the method of analysis ASTM E 256-88 and the decrease of the band assigned to CH stretching vibrations as well as to the increase of the bands assigned to C-Cl stretching (see Annex of Deliverables).

Wet GSA and CL (100 g powder + 500 uL water) was treated with CMS21, CMS34 and CMS38 and CMS44 (dissolved in methanol, 50 mg/mL) with has been started. CMS samples were dissolved in methanol (50 mg/mL) (procedure A). Another procedure was agreed with COLORTECH to simulate the actual leather treatment. One g of GSA or CL was treated with 1 g of CP30 or CP44 (for comparison) or CMSs or Cl-FAME or FAME or Cl-FA or chlorinated or not-chlorinated Palmkernel Oil FAME. The mixture was stirred for 10 min at 30°C or 60°C, rinsed (3-4 times) in hexane to remove the excess of fattening agent and dried in air

before analysis (procedure B). The protocols of analysis are reported in the Annex of Deliverables.

The results obtained on CMS-treated CL and gelatins are summarized below.

CMSs interact with CL, GSA and GSB and this interaction is more effective in CMS at higher Cl content (CMS38 and CMS 44). As observed for CPs, FTIR did not show any band suggestive of newly formed covalent bond. Therefore, this interaction can be classified as not covalent and due to electrostatic interactions (ionic bonds between Asp⁻ and Lys⁺ and hydrogen bonds), hydrophobic interactions and Van der Waals forces.

Following the B procedure, the results agreed with data obtained in A procedure. It is interesting to observe that also chlorinated FAME and not chlorinated FAME, chlorinated Palmkernel Oil FAME and not chlorinated Palmkernel Oil FAME interact with gelatin, demonstrating the possibility of using not chlorinated natural compounds.

The results obtained helped us to elucidate the chemical mechanism of interaction of chlorinated compounds with leather proteins. Chlorinated compounds have indeed only one functional group (Cl) that give us all the information on this kind of substitution products. The comparison of these results with those obtained with chlorosulfonated products gave information to study specifically the interaction mechanism of SO₂Cl group with leather proteins.

Investigation on natural products substitutes of solfochloroparaffins: solfochlorinated methyl stearate (SCMS), solfochlorinated Palmkernel Oil FAME.

The study of the interaction of the natural products developed by SERICHIM for the substitution of solfochloroparaffins was also completed. 1,5 g of GSA or CL were treated with 5.4 mL of NaHCO₃ saturated solution stirring for 10 min at 30°C or 60°C. Then, 0 (blank), 300 (20% w/w of protein) or 900 mg (70% w/w of protein) of SCP (as comparison) or SCMS or solfochlorinated Palmkernel Oil FAME were added and the mixture incubated at 30 or 60°C for 30 min. Thirty degrees is the temperature typically used during tanning process; 60°C was investigated to explore different operating conditions. After this 300 or 900 mg PEG 200 (polyethyleneglycol) were added in order to remove the excess SCP, stirring for 10 min. The modified gelatin or CL was rinsed with MilliQ water and centrifuged (3000 g for 10 min) until the solution reached a neutral pH. The samples were dried in air before the analysis. For collagen the same procedure was scaled up (because of the high cost of pure collagen) using 36 mg of pure collagen in each experiment and only the treatment with 70% SCP was performed.

As described in detail in the Annex of Deliverables, all the solfochlorinated natural products strongly interact with GSA, collagen and CL. FTIR spectra showed new absorption suggestive of the formation of sulfonamide bonds.

The application trials performed by COLORTEX (described in the following Action 4) suggest a quite good performance of the new developed chemicals compared with the standard ones. These results indicate that the assumptions described in the planned project are correct and the project can run as indicated in the future steps.

All the technical issues related to Action 3 are analyzed and defined in detail in the Deliverable documents in the ANNEX of Deliverables.

As scheduled, this action has been completed by 100%.

5.1.4. Action 4 Environmental demonstration of natural products at laboratory level.

This action started in July and it was completed in March 2013.

COLORTEX and SERICHIM produced standard samples, taking chlorine and chlorosulfonated paraffins as a reference, analyzing and assessing the performances of reference samples. In particular during this action phase SERICHIM focused his activity in

the production of Palm Kernel Oil based substitutes of chlorinated and sulphochlorinated paraffins at kg lab-scale.

COLORTEX produced leathers from bovine and ovicaprine raw hides tanned with standard chrome tanning and fatliquored with a specific formulate containing a defined amount of the natural product CMS38 compared with CP44. The treatment was performed to produce soft nappa and nubuk articles. CMS38 was selected to develop the application test because its physical properties were similar to CP44.

Figures 6A and B shows the pictures of samples of chrome tanned leather treated by COLORTEX with CP44 (left) and CMS38 (right) fatliquoring formulation.

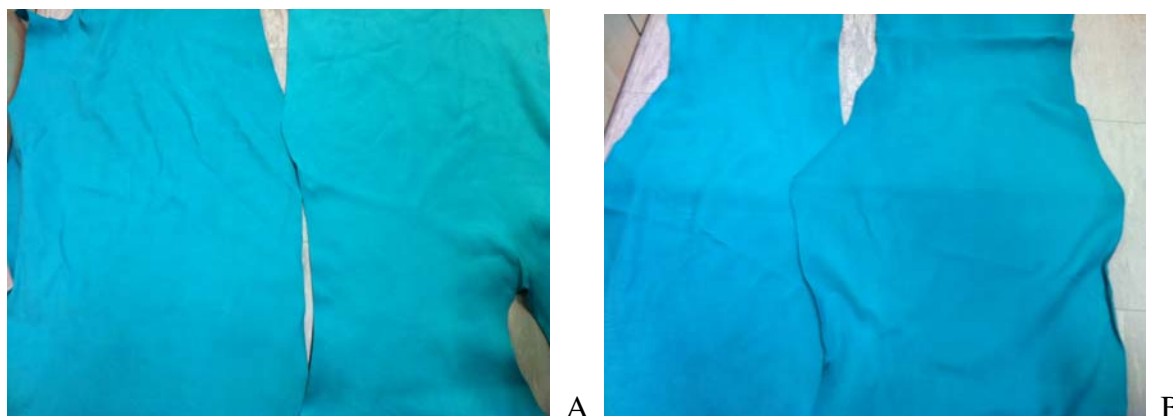


Figure 6. Samples of chrome tanned leather treated by COLORTEX with CP44 (left) and CMS38 (right) fatliquoring formulation.

No remarkable differences were observed in FTIR spectra. However, some different physical properties (see below) were revealed. This confirms that theoretical assumptions made in the project planning were correct.

The articles obtained were quite similar. The differences observed among CMS38- and CP44-treated samples are the following:

- CMS38-treated samples were lightly hard, with a oily touch (not so silky), more shining, and they present a better “writing effect” (on nubuk articles), with very good buffing properties.

To better understand the effect of the new natural products on leather, COLORTEX performed also different trials on chrome tanned leather (Figure 7A) and vegetable tanned leather (Figure 7B) using CP44 and CMS38 as finishing chemical. In this process the product is applied on leather by using roller coating machine. Due to this application most of the chemicals were localized only on the leather surface.

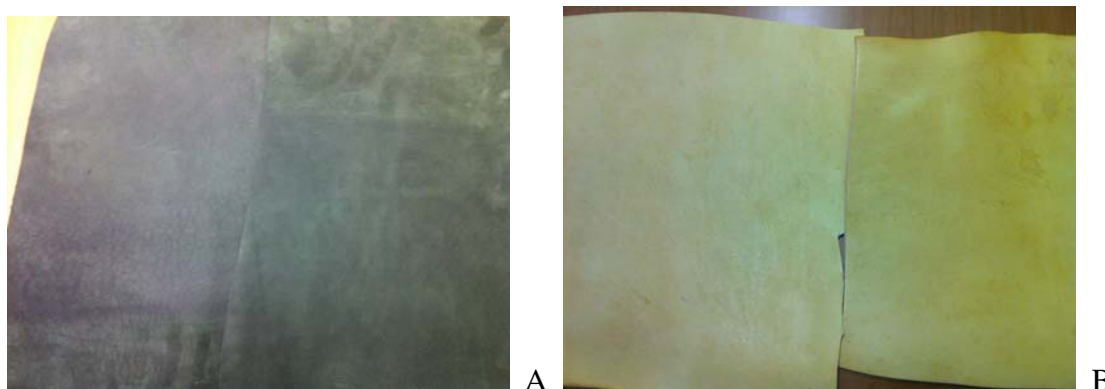


Figure 7. Chrome tanned leather (A) and vegetable tanned leather (B) treated with CP44 (left) and CMS38 (right) as finishing chemical.

The differences observed on these samples were analogous to those reported above. However, several features were more evident.

On vegetable tanned leather we can observe a reduced “waxy” effect of CMS38.

This effect can be explained on the basis of FTIR results (see Annex of Deliverables) that showed that an highest chlorine content improves the interaction with the protein matrix. Thus, a reduced Cl percentage in CMS38 compared with CP44 may increase the penetration of this chemical through the section of treated leather, which is responsible for the reduced “oily” surface.

From this experience developed in Action 3 and 4 we understood that Cl content is fundamental for the chemical performance of the product and that the right comparative chemical of CP44 will be a CMS derivate containing 44 w/w% Cl substitution. However, the physical characteristics of this chemical will be different from CP44.

From these results emerge that structural chemical characteristic more than physical properties are important to obtain similar application results.

Good results were also obtained on leather samples using SCMS (Figure 8). However the best results were obtained using Cl-Palmlnel oil (as substitute of CPs) and SCI-Palmkernel oil FAME (as substitute of SCP).



Figure 8. Leathers tanned using SCMS (ocra leathers) and fatted with CMS (cyan leathers). Twelve month meeting in Torviscosa.

For the quality characteristics of the products, these two compounds were definitely selected for the future semi-industrial and pre-industrial actions.

Once these products were selected by COLORTECH and SERICHIM, and after the characterisation of the 10 reference fatliquoring product families, the same laboratory tests were conducted in INESCOP on the natural-origin products developed in the project.

The results obtained in these tests were compared with the reference values so as to be able to assess the improvement of the environmental impact of the products developed, always maintaining the quality of leather.

Concerning the appearance of the leather samples obtained, in all cases the assessed fatliquoring products conferred adequate softness, fullness and flexibility on the leather. Some differences in shade were observed, which were not considered significant.

Table 4 shows the results obtained in the tests using the natural fatliquoring products selected as optimum for the fatliquoring stage (laboratory scale test with bovine leather):

Table 4. Characterisation of bovine leather fatliquoring baths

(Ecofattening fatliquoring products/ laboratory scale tests)

Reference		pH	Conductivity ($\mu\text{s}/\text{cm}$)	COD ($\text{mg O}_2/\text{l}$)	BOD ₅ ($\text{mg O}_2/\text{l}$)	Biodegradability (BOD ₅ / COD)
1-10 Fatliquoring product families' average		3.8	2,750	15,360	6,290	0.41
CLP	Chlorinated paraffin (44 % Cl)	3.3	6,500	12,600	5,540	0.44
FAME	Chlorinated vegetable fatty acid methyl ester (48.6 % Cl)	3.2	5,100	12,800	7,170	0.56
CLP_S	Sulpho-chlorinated paraffin (44 % Cl)	2.4	12,100	10,300	4,225	0.41
FAME_S	Sulpho-chlorinated vegetable fatty acid methyl ester (38 % Cl- 8.6 % S)	2.4	10,200	5,440	2,990	0.55

The results obtained show that the biodegradability of the FAME fatliquoring bath samples (based of fatty acid methyl esters) improves by 34 - 36% with respect to the average value of the assessed fatliquoring products (1-10 product families).

Furthermore, the leather samples obtained during the tests on a laboratory scale were subjected to different quality control processes according to international standards (EN-ISO) to test their suitability to be used in the manufacture of footwear components. Table 5 shows the results of the physical characterisation of the bovine hides.

Table 5. Physical characterisation of bovine leather (laboratory scale tests)

Reference	Tear strength (N)	Tensile strength (N/mm^2)	Elongation at break (%)	Matter soluble in Cl_2CH_2 (% m.s.)	Chromium(VI) (mg/kg)
1-10 Average	156	17	72	4.4	14.3
CLP	85	10.7	49.3	8.6	2.6
FAME	119	20.3	66.0	7.7	2
CLP_S	331	25.4	85.3	10.1	2.3
FAME_S	214	21.4	78.9	10.1	1.8
Recommended values	>150	>15	>40	>3	> 3

The determination of the physical parameters of leather demonstrated that the recommended values for the manufacture of footwear were fulfilled..

All the technical issues related to Action 4 are analyzed and defined in detail in the Annex of Deliverables. As scheduled, this action has been completed by 100%.

5.1.5. Action 5 Fattening at a semi-industrial level by using natural products.

This action started in July 2012. Currently it is in progress and it will be completed by 30 June 2013.

Different types of raw hides (from bovine, sheep and goat) were selected by COLORTEX and INESCOP and we started the tanning process to stabilize leather proteins and provide a good leather's storage.

SERICHIM studied the scale up of the pilot production of Cl-Palmlnel oil, as substitute of CPs, and SCI-Palmkernel oil, as substitute of SCP. For the pre-industrial step SERICHIM produced 2 kg of products, which were enough for the preliminary experiments in COLORTEX and INESCOP.

In order to rely on an effective apparatus to provide – at “few kilograms scale “ – chlorinated and sulphochlorinated samples, a specific equipment for carrying out chlorination reactions was studied, assembled and operated.

Figure 9 shows the pilot plant located in SERICHIM laboratories used for the pre-industrial production. This will be scaled up and used also for the industrial-scale production.



Figure 9. Pilot plant located in SERICHIM laboratories used for the production of natural products.

SERICHIM activity was therefore constantly devoted to the production of kg samples that was targeted – on the basis of the indications coming from downstream project partners - as the most promising both in terms of industrial effectiveness and reproducibility and also in terms of “environmental friendship“.

More precisely, on the basis of the results obtained from previous actions 2 and 3 and following discussion with project partners , mainly COLORTEX and ICCOMCNR it was established:

- 1) the PALM KERNELOIL as the most suitable natural origin substrate to be chlorinated and sulphochlorinated as alternative to currently used chlorination and sulphochlorination of n-paraffins. A commercially available product PALM KERNEL OIL was used being his composition the following as far as the distribution of alkyl chain lengths was concerned :

<i>C10</i>	0% - 3%
<i>C12</i>	54 % – 59%
<i>C14</i>	17 % – 21%
<i>C16</i>	8 % - 11%
<i>C18</i>	9 % - 17 %

- 2) to increase chlorine content in the sulpho-chlorinated product compared to previous Palm kernel Oil based samples – as per above mentioned *Lot 130116 and Lot 130118* supplied to COLORTEX and ICCOMCNR

The following samples were prepared and supplied to COLORTEX and to INESCOP

- CHLORINATED PALMKERNEL OIL FAME (Lot 130422) (48,6 % m/m Chlorine content - 2,70 kg)

-SULFO CHLORINATED PALMKERNEL OIL FAME (Lot 130404) (38,0 % m/m Chlorine content - 8,6% m/m sulfur content - 1,00 kg)

Simultaneously COLORTEX ran preliminary tests on selected leather samples were performed by using the selected natural products (Cl-Palmlernel oil, as substitute of CPs, and SCI-Palmkernel oil, as substitute of SCP), optimizing a protocol (formulations) for the hide treatment.

After completing the laboratory-scale tests using the products that had been selected by COLORTEX and SERICHIM, the same semi-industrial scale tests were conducted in INESCOP on the natural-origin products developed in the project. As in Action 4, the results obtained in these tests were compared with the reference values so as to be able to assess the improvement of the environmental impact of the products developed, always maintaining the quality of leather.

Concerning the appearance of the leather samples obtained, in all cases the assessed fatliquoring products conferred adequate softness, fullness and flexibility on the leather. Some differences in shade were observed, which were not considered significant.

Table 6 shows the results obtained so far in the tests using the natural fatliquoring products selected as optimum for the fatliquoring stage (semi-industrial scale test with bovine leather):

Table 6. Characterisation of bovine leather fatliquoring baths (Ecofattening fatliquoring products/ semi-industrial scale tests)

Reference		pH	Conductivity (µs/cm)	COD (mg O ₂ /l)	BOD ₅ (mg O ₂ /l)	Biodegradability (BOD ₅ / COD)
1-10 Fatliquoring product families' average		3.6	2,130	12,010	3,612	0,31
CLP	Chlorinated paraffin (44 % Cl)	3.7	5,520	12,800	5,120	0.40
FAME	Chlorinated vegetable fatty acid methyl ester (48.6 % Cl)	3.6	3,960	13,100	6,812	0.52
CLP_S	Sulpho-chlorinated paraffin (44 % Cl)	3.6	6,150	13,600	4,800	0.36
FAME_S	Sulpho-chlorinated vegetable fatty acid methyl ester (38 % Cl- 8.6 % S)	3.7	5,100	10,400	5,340	0.51

The tests completed so far show that the biodegradability of the FAME fatliquoring bath samples (based of fatty acid methyl esters) improves by 27-34% with respect to the average value of the assessed fatliquoring products (1-10 product families).

Furthermore, the leather samples obtained during the tests on a semi-industrial scale were subjected to different quality control processes according to international standards (EN-ISO) to test their suitability to be used in the manufacture of footwear components. Table 7 shows the results of the physical characterisation of the bovine hides.

Table 7. Physical characterisation of bovine leather (semi-industrial scale tests)

Reference	Tear strength (N)	Tensile strength (N/mm ²)	Elongation at break (%)
1-10 Average	211.8	17.4	85.9
CLP	136	20.6	59.1
FAME	142	16.6	72.1
CLP_S	240	17.2	66.2

FAME_S	160	18.2	45.3
Recommended values	>150	>15	>40

The determination of these physical parameters of leather demonstrated that the recommended values for the manufacture of footwear were fulfilled and the pending tests will be completed in the coming weeks.

Environmental validation was performed by INESCOP and ENEA (90%) and it is still in progress (10%). This action has been fundamental to adjust and control the fatting process at a pre-industrial level.

This action will be completed with the production of the amount of products required for the industrialization tests. We foreseen that this production will be completed between May 31st and June 15th 2013. At that point, COLORTEX and INESCOP will produce with the natural products the tanned, fatted leather, in the next 15-20 days.

As scheduled, this action has been completed by 90%.

5.1.6. Action 6. Environmental demonstration of natural products fatting at a pre-industrial level.

This action started in October 2012, it is in progress, and it will be completed in September 2013.

In order to achieve the target of environmental demonstration at pre- industrial level, availability of selected PALM KERNEL OIL based chlorinated and sulpho-chlorinated products have to be granted to project partners at “ten kilograms“ level.

This scale of production would be very time consuming and too “operational intensive“ if approached with the existing apparatus. For this reason SERICHIM has studied and is now proceeding to the set up of a semi-industrial apparatus able to carry out chlorination and sulpho-chlorination reactions of organic substrates based on the original know how of SERICHIM on “CONTINUOUS FLOW TECHNOLOGY“

The advantages of such techniques are several and will be very important in case of industrial production being mainly related to:

- High volume production with a small equipment compared to the traditional batch photochlorination reactors
- Increase of safety in the production process due to lower hold up involved
- Constant quality
- Low operational cost and fixed investment required

At the same time COLORTEX has already bought raw hides for this action. All hides were pre-tanned making them ready for the process of fatting with natural products (wet blue for Cl-Palmkernel oil FAME and picled for SCl-Palmkernel oil FAME). The industrial production of leathers tanned with the natural products will start in the Italian and Spanish tanneries as 100 Kg of natural products (Cl-Palmkernel oil FAME as substitute of CPS and SCl-Palmkernel oil FAME as substitute of SCP) will be ready (see Action 5: between may 31st and June 15th 2013).

ICCOMCNR and ENEA set up chemical-physical tests (FTIR spectroscopy, termogravimetric analysis, TGA, scanning electron microscopy, SEM) to assess the quality of leather samples produced with the new method. These tests have been set up using leather samples prepared in Actions 4 and 5.

ENEA and INESCOP are taking care of giving an environmental assessment of the new fatting process in tanning cycle. This part is still in progress.

As scheduled, this action has been completed by 60%.

5.1.7. Action 7 Environmental demonstration of hides fatted with natural products

This action started in January 2013, it is in progress, and it will be completed in December 2013.

Few samples of hides have been prepared with the 2 kg batch of natural products produced in the pre-industrial step (action 5). This allowed us to optimize formulations and protocols that will be used in the industrialization step, as well as to compare the leathers obtained new tanning/fatting method with those obtained with CPs and SCP.

A selection of about 100 leather products to be produced with the new process has been performed:

- 4 wallets for men and 4 wallets for woman
- 4 bags
- 3 pillows
- 2 jackets
- 2 briefcase
- 80 pair of shoes

INESCOP will take care of the validation of harmful substances in hides based on international standards (European Eco-label for ecological criteria-Decision 2002/231/CE-) and other chemical parameters of environmental interest. This part will be performed as the action 5 proceeds.

As scheduled, this action has been completed by 40%.

5.1.8. Action 8 Study of the demonstration about the environmental benefits from the natural products fattening process

This action just started in April 2013, it is in progress, and it will be completed in December 2013.

Once we'll have all the products INESCOP will prepare a report of the results related to the production validation carried out in the Spanish companies and the results of the comparison between leather products manufactured from hides treated with natural products (CI-Palmkernel oil FAME and SCI-Palmkernel oil FAME) and CP fatted/tanned hides.

As scheduled, this action has been completed by 20%.

5.1.9. Action 9. Quality assessment of leather products production

This action just started in April 2013, it is in progress, and it will be completed in December 2013.

In this action we have to verify that hides fatted with natural products satisfy leather product quality standards. INESCOP and COLORTEX laboratories started selecting the chemical-physical validation methods (tensile strength, resistance to wear, contraction temperature, ecc...) to be carried out on hides produced to manufacture leather products in Italy and Spain, in compliance with international standards (EN, ISO).

In particular the following tests have been selected:

- Resistance
- Tensile strength
- Elongation percentage
- Contraction temperature
- Thickness
- Feel
- Fullness
- Yellowing
- Creases

- Grain strength

In particular these methods have been already performed on leather products produced with hides conventionally tanned/fatted with CPs and SCP, as comparison.

As scheduled, this action has been completed by 20%.

5.1.10. Action 13 Material preparation for workshops

During this period, all partners prepared various dissemination materials to be used in fairs, conferences, newsletters, etc, in particular:

- Logo definition and design performed. An ECOFATTING logo was created for the project, which will be shown on all dissemination documents of the project.
- ICCOMCNR produced 1 banner in Italian and 1 banner in English
- ICCOMCNR produced 200 brochures of the project in Italian and 200 brochures in English
- ICCOMCNR produced 400 eco bags as project gadget
- ICCOMCNR produced 1 roll up in Italian and 1 roll up in English
- ICCOMCNR produced an official ECOFATTING power point presentation in English and Italian to be used in events

During the same period, INESCOP prepared several dissemination materials, in particular:

- a poster, hanged in INESCOP premises
- power point presentation in Spanish for dissemination actions in fairs, conferences, newsletters, etc.

The above mentioned material is detailed in the ECOFATTING Annex Dissemination activities.

5.1.11. Action 14 Diffusion material preparation

During the first period of the ECOFATTING project ICCOMCNR created the structure of the project Notice board and produced 10 ECOFATTING Notice boards, which were sent to all the partners and displayed in visible spots and accessible places to the public on the partners' premises. During this period, INESCOP prepared a specific different ECOFATTING notice-board, too.

ICCOMCNR carried out two TV interviews with local TV agencies.

COLORTEX has started to contact technical magazines.

From January to September 2012, INESCOP presented the ECOFATTING project through the newsletters that are distributed in electronic and paper form to INESCOP's member companies (mainly tanneries and footwear and leather goods manufacturers).

- INESCOP Environment Newsletter, No. 140, January 2012
- INESCOP Environment Newsletter, No 141, February 2012
- INESCOP Environment Newsletter, No 143, April 2012
- INESCOP Environment Newsletter, No 145, June 2012
- INESCOP Environment Newsletter, No 146, July 2012
- INESCOP News, No. 237, June 2012
- INESCOP Environment Newsletter, No 151, December 2012

Press contacts and articles related to ENEA event for the 20th Anniversary of the LIFE Programme, Faenza, June 21st, 2012: two press releases have been made by ENEA. ICCOMCNR was responsible of the edition of 1 article edited by a Pisa local newspaper.

The above mentioned diffusion material and activities are detailed in the ECOFATTING Annex Dissemination activities.

5.1.12. Action 15 Training course for Italian tanneries

This action just started in April 2013, it is in progress and it will be completed in December 2013.

A training course specifically aimed at tanning companies has been planned in COLORTEX on May 31st with the following program:

- Presentation of Life Program and ECOFATTING project.
 - Description of the results of ECOFATTING obtained on the study of the interaction of leather proteins with chloroparaffins, chlorosulfonated paraffins and the developed natural products, CI-FAME SCI-FAME.
 - Applicative processes and formulations for the production of leather products with CPs, SCP, CI-FAME, SCI-FAME: comparison and advantages of natural products.
 - demonstration of hides tanned/fatted with CPs, SCP, CI-FAME, SCI-FAME.
 - Demonstration of environmental benefits of natural products.
 - Demonstration and discussion of legislative developments
 - Practical section with the demonstration of the application of the new process at a semi-industrial level, using a tanning pilot plant in COLORTEX.
- COLORTEX is currently collecting the participant registration forms.

5.1.13. Action 16 Training course for Spanish tanneries

This action just started in April 2013 and it is in progress (30% is done). As planned, the training course specifically aimed at tanning companies will be held at INESCOP premises on June 20th with the following programme:

- The LIFE+ ECOFATTING project: background, objectives and stages.
- Identification and description of raw materials used and their processing.
- Results achieved:
 - Chemical characterisation of fatliquoring products and comparative assessment of their environmental impacts.
 - Physical and chemical characterisation of the leather obtained and assessment of its suitability for the production of leather articles.
- Practical section with the demonstration of the application of the new process at a semi-industrial level, using a tanning pilot plant in INESCOP.
- Comparative assessment of the results achieved (practice): appearance, feel, flexibility, colour, fullness, firmness.
- Conclusions and round table.

INESCOP has prepared a leaflet for course dissemination. This leaflet is being circulated to the sector industries with the collaboration of Spanish leather-related associations. Figure 10 shows the leaflet prepared for course dissemination.

The image displays a registration form and a promotional leaflet for a course titled "Curso presencial" on innovative tanning technologies. The registration form includes fields for "Nombre:" and "Empresa:", and a "Programa:" section detailing the course schedule from 9:00 to 14:00. The leaflet features logos for INESCOP, LIFE3 ENV/H/000364, and ECOFATTING, along with descriptive text about the course.

Figure 10. Leaflet of Ecofating Training Course

5.1.14. Action 19 Internationals fairs and other events

In this project period, the following activities were carried out related to this Action 19:

- ECOFATTING power point and video presentations at the Italian Celebration Day for the 20th Anniversary of the LIFE Programme, Brescia, May 25th, 2012
- ECOFATTING power point presentation at “XXII Settimana della Cultura Scientifica e Tecnologica” in Faenza, Aprile 18th, 2012
- ICCOM-CNR presented ECOFATTING in two national meetings:
 - XXI National Meeting of Italian Society of Pure and Applied Biophysics (SIBPA), 17-20 September 2012;
 - XXIII National Meeting of Analytical Chemistry, Italian Chemical Society, La Biodola (Elba), 16-20 September 2012: the description of part of the results of Action 1 were presented in a published abstract and in a poster.
 - Po.Te.Co. (Polo tecnologico conciaro) in Castelfranco di sotto (PI), 10/12/2012
- ENEA presented a poster in the 3rd International Conference on Industrial and Hazardous Waste Management which was hold in Chania (Crete, GR) on September 12-14th, 2012.
- INESCOP presented the project in different national and international fairs listed below:
 - 21st Edition of ECOFIRA 2012, International Fair of Environmental Solutions. Valencia (Spain), 29th February – 2nd March 2012.
 - 12th Edition of Green Week, Brussels (Belgium), 22nd – 25th May 2012
 - Conference in Green Week Satellite events; “Regional responses to the EU2020 on water. Lessons learned through European projects”, FCVRE, Brussels (Belgium), 22nd May 2012.
 - 1st Water, Waste and Energy Management, Salamanca (Spain), 23rd – 25th May 2012
 - Industrial Technologies Congress, 2012, Aarhus (Denmark), 19th – 21st June 2012
 - 18th Congress of the Latin American Federation of Leather Chemists and Technologists, Montevideo (Uruguay), 9th - 11th October 2012.
 - 28th Edition of the International Footwear Fair, FUTURMODA, Alicante, (Spain), 30th – 31st October 2012
 - 29th Edition of the International Footwear Fair, FUTURMODA, Alicante (Spain), 17th – 18th April de 2013.
 - 62nd Congress of the Spanish Leather Chemists Association AQEIC; Lorca – Murcia (Spain), 10th – 11th May 2013
 - LIFE+ Networking Event, Valencia (Spain), 14th May 2013

The participation at the project events is detailed in the ECOFATTING Annex Dissemination activities.

5.1.15. Action 20 Digital supports for international diffusions

ENEA is the project responsible for the selection of external service video expert for the collection and mixing of each associated beneficiary activities video and production of the global ECOFATTING video.

In this project period ENEA started all the internal procedures for the external service video expert selection.

5.1.16. Action 21 International diffusion and dissemination

- ICCOMCNR has produced an official ECOFATTING power point presentation in English and Italian to be used in events
- INESCOP has produced an official ECOFATTING power point presentation in Spanish to be used in events
- Cluster with OXATAN, SHOELAW, PODEBA, SOREME, BioNaD, CLEANSED, After-Cu, MICROTAN, C02SHOE, SHOEBAT and BIOREM LIFE 09-10-11-12 projects
- ECOFATTING website in Italian, English and Spanish: www.pi.iccom.cnr.it/ecofatting/it
- Since May 2012 a link has been available on all the partners website to the official project website

The above mentioned diffusion material and activities are detailed in the ECOFATTING Annex Dissemination activities.

5.1.17. Action 23 Project management

The project coordination actions need daily work to maintain a permanent flow of action with the aim of achieving the objectives set. The actions carried out were:

- Preparation of the Partnership Agreement and relative Addendum
- Coordination meetings:
 - Project kick-off meeting (January 2012, Italy)
 - 6 month progress and coordination meeting (June 2012, Italy)
 - 12 month progress and coordination meeting (January 2013, Italy)
- Organisation of different meetings between some partners in order to plan and monitor the project technical activities
- Continuous contact between all project partners for monitoring project activities
- Preparation of material for meetings.
- General actions and activities for the coordination of the project.
- Management of the financial aspects of the project.
- Monthly reports to the LIFE external team monitor on the evolution of the project.

During this period, the 4 beneficiaries associated, ENEA, Colortex, Serichim and INESCOP participated in project management activities, keeping in smooth contact with the project coordinator and the other partners. In this sense, they prepared and attended the project management meetings and collaborated with the project coordinator (ICCOMCNR) in the preparation of the Inception Report and of this Progress Report, as set out in the project proposal.

5.1.18. Action 24 Monitoring

During the first seventeen months of execution, monitoring tasks have been carried out for each action, reflecting the general indicators obtained in table 1 at the start of this report (Table 1. Progress from 1st January to 31st May 2013). In particular:

- ICCOMCNR, as project coordinator, has continuous contact with all project partners for monitoring project activities
- ICCOMCNR, as project coordinator, prepares and sends a monthly indication of operative activities to be done to all the partners
- ICCOMCNR, as project coordinator, prepares and sends a monthly summary of the project activities carried out to monitoring representant and to all the partners

5.2. Envisaged progress until next report.

Number/name of action	2012				2013			
	I	II	III	IV	I	II	III	IV
Action 1. Study on the different fatliquoring agents currently used in the EU tanneries	/	/						
Action 2. Study on the fatliquoring agents environmental impact	/	/	/	/				
Action 3. Natural products demonstration and evaluation		/	/	/	/			
Action 4 Environmental demonstration of natural products at laboratory level		/	/	/	/			
Action 5. Fattening at a semi-industrial level by using natural products			/	/	/	X		
Action 6. Environmental demonstration of natural products fattening at a pre-industrial level				/	/	X	X	
Action 7. Environmental demonstration of hides fattened with natural products					/	X	X	X
Action 8. Study of the demonstration about the environmental benefits from the natural products fattening process						X	X	X
Action 9. Quality assessment of leather products production						X	X	X
Action 10. Demonstration of technical-economic viability							X	X
Action 11. Natural products fattening manual							X	X
Action 12. Leather sample books of hides fattened with natural products							X	X
Action 13. Material preparation for workshops	/	/	/	/	/	X	X	X
Action 14. Diffusion material preparation		/	/	/	/	X	X	X
Action 15. Training course for Italian tanneries						X	X	X
Action 16. Training course for Spanish tanneries						X	X	X

Action 17. Demonstration workshop in Italy								
							X	X
Action 18. Demonstration workshop in Spain								
							X	X
Action 19. International fairs and other events	/	/	/	/	/			
							X	X
Action 20. Digital supports for international diffusion					/			
							X	X
Action 21. International diffusion and dissemination	/	/	/	/	/			
							X	X
Action 22. After-LIFE Communication Plan								
								X
Action 23. Project management by ICCOMCNR	/	/	/	/	/			
							X	X
Action 24. Monitoring	/	/	/	/	/			
							X	X
Action 25. Audit								
								X

Ke:  Task foreseen in the proposal  Actual task duration  Next actions until project end

In particular the following activities of the following ACTIONS will be carried out until project end:

5.2.1 Action 5 Fatting at a semi-industrial level by using natural products

In the last month of Action 5 SERICHIM will complete the production of the amount of products required for the industrialization tests. At that point, COLORTEX and INESCOP will produce with the natural products the tanned, fatted leather, in the next 15-20 days. INESCOP and ENEA will complete the environmental validations (residual water, residues, etc.) of the new fatting process compared to traditional fatting phase. This action will be continue up to month 18 of the project development as planned.

5.2.2 Action 6 Environmental demonstration of natural products fatting at a pre-industrial level

This Action started at month 10 and will foresee the tanning of the leather produced in previous Actions with the natural products technique in the fatting phase. ICCOMCNR, ENEA and INESCOP will conduct a product assessment of the leather samples produced with the new method and will finalize the environmental product characterization of the leather produced with the treated leather.

5.2.3 Action 7 Environmental demonstration of hides fatted with natural products

This action started in January 2013 and will foresee the production of 100 leather products elaborated with natural products fatted leathers.

5.2.4 Action 8 Study of the demonstration about the environmental benefits from the natural products fattening process

This action started in April 2013 and will foresee the production of a report which will contain the results from the production validations, as well as the results of the comparison between leather products manufactured from natural products fatted hides and chloroparaffines fatted hides

5.2.5 Action 9 Quality assessment of leather products production

This action started in April 2013 and will foresee the implementation of physical validation tests (tensile strength, resistance to wear, contraction temperature, etc.) on hides produced to manufacture leather products in Italy and in Spain.

5.2.6 Action 10 Demonstration of technical-economic viability

This Action will start at month 18 and will foresee a deep analysis in order to prove that hides tanned with the new natural products method comply with quality standards and are economically viable.

5.2.7 Action 11 Natural products fattening manual

This Action will start at month 18 and will foresee the production of a formative manual which explains how to apply the new natural products fattening technique to the industrial process in tanneries.

5.2.8 Action 12 Leather sample books of hides fatted with natural products

This Action will start at month 18 and will foresee the production of hide sample books tanned with the new natural products fattening technique, which can be shown at different events.

5.2.9 Action 13 Material preparation for workshops

ICCOMCNR, with the support of all the partners, will produce more ECOFATTING dissemination material in relation with the organisation and participation at project events and activities.

5.2.10 Action 14 Diffusion material preparation

All the ECOFATTING partners will be responsible for the production of more press articles and diffusion activities in relation with the progress of the project activities.

5.2.11 Action 15 Training course for Italian tanneries

A training course specifically aimed at tanning companies has been planned in COLORTEX on May 31st

5.2.12 Action 16 Training course for Spanish tanneries

A training course specifically aimed at tanning companies has been planned in INESCOP on June 20th.

5.2.13 Action 17 Demonstration workshop in Italy

A demonstration workshop specifically aimed at business people from Italian tanneries and leather companies has been planned in COLORTEX during November 2013.

5.2.14 Action 18 Demonstration workshop in Spain

A demonstration workshop specifically aimed at business people from Spanish tanneries and leather companies has been planned in INESCOP during November 2013.

5.2.15 Action 19 International fairs and other events

All the ECOFATTING partners will be responsible for the participation to some public fairs, conferences, events externally organized where beneficiaries can present and disseminate the ECOFATTING project in relation with the progress of the project activities.

In particular ICCOM and ENEA will participate at:

- Colloquium Spectroscopicum Internationale, Thomso 16-20 June 2013
- XIV National-event-of-environmental-chemistry, 2-5 June 2013, TUMA
- Ecomondo (October-November 2013), .

- I° National Workshop "Green Chemistry-Sustainable Chemistry", Bologna, 12th of July

All the ECOFATTING partners will be responsible for the organisation of some informative workshops, seminars, conferences and other events organized only for the project (i.e. in the premises of beneficiaries, ...) in relation with the progress of the project activities.

5.2.16 Action 20 Digital supports for international diffusion

ENEA will produce an ECOFATTING video about the project results, collecting and mixing specific videos of each project beneficiary activity.

5.2.17 Action 21 International diffusion and dissemination

ICCOMCNR, with the support of all the partners, will update the ECOFATTING project website in relation with the progress of the project activities.

All the ECOFATTING project partners will continue to contact similar projects in order to collate information, experience and feedback, stimulating an international exchange of ideas among consortia that have been working in the past or present on similar topics.

5.2.18 Action 22 After-LIFE Communication Plan

ICCOMCNR, with the support of all the partners, will produce the "After-LIFE Communication Plan".

5.2.19 Action 23 Project management

ICCOMCNR, with the support of all the partners, will continue with daily work of project management in order to maintain a permanent flow of actions with the aim of achieving the objectives set. In particular:

- Organisation of 4th Coordination meeting in December 2013
- Organisation of different meetings between some partners in order to plan and monitor the project technical activities
- Management of the financial aspects of the project.
- Monthly reports to the LIFE external team monitor on the evolution of the project.

5.2.20 Action 24 Monitoring

ICCOMCNR, with the support of all the partners, will continue to monitor the execution of project activities in order to verify the status of actions compared to the expected timing of the project. In particular:

- ICCOMCNR, as project coordinator, will have continuous contacts with all project partners for monitoring project activities

- ICCOMCNR, as project coordinator, will continue to prepare and send a monthly indication of operative activities to be done to all the partners
- ICCOMCNR, as project coordinator, will continue to prepare and send a monthly summary of the project activities carried out to monitoring representant and to all the partners

5.2.21 Action 25 Audit

ICCOMCNR will produce a financial declaration made by an independent Italian auditor.

5.3. Impact:

Natural product developed in ECOFATTING project for leather fattening and hide tanning represent a step forward the evolution of tanning process in a “green”, environmental-oriented direction. These products resulted, indeed, more performing than currently used CPs and SCP and more biodegradable, with a resulting advantage in terms of waste water treatment.

The natural palm oil selected is the cheapest among palm natural oils and contains the smallest percentage of unsaturated fatty acids, which makes it less suitable for human consumption.

This project is aimed at European tanneries and at companies manufacturing leather products. More than 95% of these companies are SMEs. In the EU, there are produced 163.320.000 m² of cattle/calf leather and 43.416.000 m² of sheep/goat leather (Source: COTANCE-Confederation of National Associations of Tanners and Dressers of the European Community). Approximately, this means about 235.000 tons of leather. Italy and Spain are the main leather producers in Europe.

From the industrial impact, the aim of this project is to demonstrate, promote and disseminate in the EU an innovative tanning technique and related processes, as an alternative to traditional fattening phase. As a result, more environmentally friendly leathers and leather products will be obtained.

European tanneries fattening using natural products will provide leathers free from chloroparaffines that in addition, have been produced in an environmentally friendly way. These leathers will be used by leather industries for the manufacture of products, thus resulting in a positive influence on the environmental effect of products made of those leathers. In this way, natural products technology will have a positive effect on the environmental design of products (eco-design), as companies willing to implement environmental criteria in the creation and development of their products, will be able to use natural products-tanned leathers as more environmentally friendly raw material.

Furthermore, the crisis that the leather sector is experiencing and the competition of third countries with low labour costs, leads to the need for new market strategies. Within this context, eco-design is presented as an innovative instrument contributing to the development of more environmentally friendly and competitive products, which in addition to providing added value, are useful products for the development of a new company approach, allowing for the identification of new business opportunities. This way, in Europe, more and more leather companies commit to eco-design as a competitive factor. Therefore, it is fundamental to make environmentally friendly raw materials, such as leather tanned using the innovative natural products fattening technique, available to them.

Finally, it is important to highlight that the development of ECOFATTING project will support the application of the Environmental Technologies Action Plan (ETAP), whose objective is to further environmental technologies to improve the environment and European competitiveness supporting eco-friendly technologies since they are good for business, reduce pressure on the environment and can create new jobs. ETAP has among its high-priority actions getting from research to markets actions improving the innovation process and

moving invention from laboratories to the market, and improving market conditions aiming at encouraging the market uptake of environmental technologies. Therefore, ETAP support the promotion of environmental technologies that has a great potential to improve the environment as well as the eco-innovation because both provide many benefits for business by fostering innovation, cutting production costs, creating jobs, reducing pressures on the environment and encouraging competitiveness.

6. Financial part

6.1. Costs incurred (summary by cost category and relevant comments).

The following table concerning the incurred project costs from the start of the project 01/01/2012 until 31 May 2013.

Budget breakdown categories	Total cost in €	Costs incurred from the start date to 31.05.2013 in €	% of total costs
1. Personnel	835.200	682.705,44	81,74
2. Travel and subsistence	62.500	19.865,34	31,78
3. External assistance	251.000	116.184,20	46,28
4. Durable goods	0	0	
Infrastructure			
Equipment			
Prototype			
5. Land purchase / long-term lease	0	0	
6. Consumables	350.000	196.624,09	56,17
7. Other Costs	0	0	
8. Overheads	100.000	69.549,69	69,54
TOTAL	1.598.700	1.087.924,10	68,05

The budget is being spent within the foreseen limits and there is no discrepancy with regard to initial estimations. The discrepancies between activities carried out and incurred costs spent is lower than expected for Travel, External assistance and Consumables is that there is a shift (at least 90 days) for payments.

The following table is based on the Form B of the proposal (costs excluding overheads):

Action number and name	Foreseen costs	Spent so far	Remaining	Projected final cost
Action 1. Study on the different fatliquoring agents currently used in the EU tanneries	92.000	92.384,565	-384,565	92.000
Action 2. Study on the fatliquoring agents environmental impact	92.000	107.088,775	-15.088,775	92.000

Action 3. Natural products demonstration and evaluation	92.000	107.755,87	-15.755,87	92.000
Action 4 Environmental demonstration of natural products at laboratory level	138.000	149.685,565	-11.685,565	138.000
Action 5. Fattening at a semi-industrial level by using natural products	148.000	166.818,615	-166.818,615	148.000
Action 6. Environmental demonstration of natural products fattening at a pre-industrial level	148.000	89.917,51	58.082,49	148.000
Action 7. Environmental demonstration of hides fattened with natural products	189.200	82.336,12	106.863,88	189.200
Action 8. Study of the demonstration about the environmental benefits from the natural products fattening process	57.000	11.400	45.600	57.000
Action 9. Quality assessment of leather products production	55.000	10.000	45.000	55.000
Action 10. Demonstration of technical-economic viability	40.000	0	40.000	40.000
Action 11. Natural products fattening manual	20.000	0	20.000	20.000
Action 12. Leather sample books of hides fattened with natural products	20.000	0	20.000	20.000
Action 13. Material preparation for workshops	43.000	30.641,63	12.358,37	43.000
Action 14. Diffusion material preparation	42.000	29.349,51	12.650,49	42.000
Action 15. Training course for Italian tanneries	36.500	10.000	26.500	36.500
Action 16. Training course for Spanish tanneries	36.500	10.000	26.500	36.500
Action 17. Demonstration workshop in Italy	20.000	0	20.000	20.000
Action 18. Demonstration workshop in Spain	20.000	0	20.000	20.000
Action 19. International fairs and other events	44.000	33.752,64	10.247,36	44.000
Action 20. Digital supports for international diffusion	58.000	0	58.000	58.000
Action 21. International diffusion and dissemination	71.500	62.206,05	9.293,95	71.500
Action 22. After-LIFE Communication Plan	0	0	0	0
Action 23. Project management by ICCOMCNR	24.000	18.026,44	5.973,56	24.000
Action 24. Monitoring	10.000	7.011,12	2.988,88	10.000
Action 25. Audit	2.000	0	2.000	2.000
TOTAL	1.498.700	1.018.374,41	480.325,59	1.498.700

7. Annexes

7.1. Deliverables

The following table details the attached documents and the relations with the Deliverables foreseen in this project period

Name of deliverable	Author	Title
Action 1-2.D1	ICCOM	Fat agents

Action 1-2.D2	ENEA	Study on the different fatliquoring agents currently used in the EU tanneries
Action 1-2.D3	ICCOM	Interaction of collagen with chlorosulphonated paraffin tanning agents: fourier transform infrared spectroscopic analysis and molecular dynamics simulations
Action 1-2.D4	ICCOM	Study of the interaction of chlorinated and sulfochlorinated paraffins with gelatin b and chopped leather. A model for fattening in the leather tanning
Action 1-2.D5	INESCOP	Fat agents. Study on the fatliquoring agents environmental Impact.
Action 3.D1	SERICHIM	Natural products
Action 3.D2	ICCOM	Natural products
Action 4.D1	INESCOP	Environmental demonstration of natural products at laboratory level
Action 4.D2	ICCOM and COLORTEX	Environmental demonstration of natural products at laboratory level

7.2. ECOFATTING Annex Dissemination activities