Contract N°: COOP-CT-2006-031287

PLASTER+

– Innovative production of high quality indoor earth plaster by adding cattail fibre –

Instrument: COOP – Co-operative Research Project

Thematic priority: Horizontal Research Activities involving SMEs

Final Activity Report

Part of D23

– Month 27 –

Due submission date: 14th August, 2008

Actual submission date: 13th November, 2008

Start date of project: 15th May 2006 Duration: 27 months

Report prepared by: BIOAZUL

FINAL Version

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

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PUBLISHABLE EXECUTIVE SUMMARY

Project Summary

Healthy life and habitation has become an important demand in Europe during the last 10 years. Due to the current ecological and health awareness, consumers are increasingly asking for the production of innovative and sustainable construction materials that do not exhale toxic chemicals and which would become the leader in the area of natural earth materials. Besides, green building design and sustainable architecture technology are improving amazingly.

A new dimension for further developments lies in the certification of earth building products. The first steps of certification of earth plasters with the new European label for sustainable building products "natureplus" are done, and other European certifications of "edificial-biology" standards will follow. Furthermore, due to existing and upcoming restrictive environmental and human health legislation, like the EU White Paper on the Strategy for a future Chemicals Policy (2001), many of the currently used toxic building materials including common plaster material with toxic additives will no longer be acceptable. Chemical substances are considered to play a major role in inducing allergies, which cost billions of euros per year. The REACH policy (the new EU chemicals legislation) and the increased public concern on health risks related to conventional indoor materials make it necessary to find substitutes or alternative materials which are healthy, economic and easy to use. Therefore, the use of unhealthy cement, lime or gypsum based plasters is aimed to be substituted through earth plasters reinforced with cattail fibres, exceeding all technical performances of conventional plasters.

Fig. D23-1: Natureplus as seal of quality

True earth plaster has very positive effects on indoor climate, health and the positive charisma of a building, and is produced in a complete sustainable manner. It regulates air-moisture and temperature, absorbs pollutants, prevents mould, is renewable, recyclable, energy efficient and durable. However, despite of the high potential market and the unbeatable positive effects of earth plaster, most earth plaster producers nowadays are not able to serve profitable a national or international market. Main reasons are:

- Missing professional technology able to produce high quantities of high quality earth plaster in an efficient way, competitive to the conventional plasters.
- Unsatisfying quality of existing earth plasters: large cracks during drying process, fungus grow due to wrong processed additives, relatively rough wall surfaces.

Consequently, the present PLASTER+ project aims to develop, to test and to optimise a high quality innovative and cost effective healthy indoor earth plaster by adding cattail fibre without any chemical additives, as well as to develop and test a highly technical automated prototype plant with minimum maintenance, which dramatically improves the production process of common earth plasters in order to improve the competitiveness of earth plaster products on the national and international plaster market.

Project Objectives

The **scientific and technological objectives** of the PLASTER+ project can be summarised as follows:

- To develop, to test and to optimize a new high quality innovative and cost effective indoor earth plaster reinforced with cattail fibre.
- To dramatically improve the production process of high quality earth plaster by developing and testing a highly technical automated prototype plant with minimum maintenance.
- To achieve much better quality criteria values then existing indoor plaster products: air moisture buffering capability higher than 14 g/m^2 at ½ hour measuring time, at a defined thicknesses of layers of plaster of 1,5 cm, at an increase of indoor air moisture from 50 % to 80 % at 21°C, tensile bending strength higher than 0,5 N/mm^2, compressive strength higher than 2,0 N/mm^2, shrinkage, resistance against shocks and abrasion, thermal storage and pollutant absorption better than the related values of usual gypsum-lime plasters, which dominated in the European plaster market.

The **environmental, wider social and policy objectives** of the PLASTER+ project are:

- To promote an innovative healthy and sustainable building material:
  - **Value for architecture**: See quality criteria above.

- **Quality of raw material:** Raw material and cattail fibre should fulfil the related quality parameters specified by CPS and SEECON in WP1 (quantity of disruptive material after harvesting, structural damages of the cattail fibre-shape caused by processing, etc.).
- **Quality of raw material:** Zero mould growth on the fibre material under normal humid storage conditions (max. 65% relative humidity).
- **Quality of the dry mixture:** Zero mould growth on PLASTER+ dry mixture under normal humid storage conditions (max. 65% relative humidity).
- **Re-usability:** PLASTER+ material fulfils following standard characteristics and technical performance criteria: abrasion, compressive strength, tensile bending strength, and resistance against shocks after use.
- **Health:** Normal human skin compatibility for people with sensitive skin. No contact hypersensitivity in humans exposed under conditions of a long-term skin contact with the fibre material. No immediate immune response (allergy).
- **Health:** No health relevant fungi growth on the processed PLASTER+ material after inocculation with Aspergillus, Penicilium or Pyronemadomesticum under normal conditions (30-60% relative air humidity) and under extreme moist indoor conditions (70% relative air humidity) under 20 ° C after 10 weeks.
- **Positive effects of PLASTER+ on human's recreation:** Positive result on transferability of accomplished studies to PLASTER+.

- To offer an alternative to unhealthy and less environment friendly plasters.
- To promote nutrient up-cycling by utilizing cattail from natural waste water recycling plants.
- To create a building material which support passive solar design. See criteria above.
- To promote a new plaster market with a high employment potential in the European building material sector by developing the first key technology for industrialized clay plaster production.
- To increase the added value of natural wastewater treatment plants and after treatment ponds for technical wastewater treatment plants by using its end product cattail as raw material for the earth plaster production.

Contractors List

Participant Role	Participant type	Participant number	Participant name	Participant short name	Country	Date enter project	Date exist project
CO	**SMEP**	**1**	natur&lehm Lehmbaustoffe GmbH	N&L	Austria	**1**	**24**
CR	**SMEP**	**2**	Clay Processing Service OÜ	CPS	Estonia	**1**	**24**
CR	**SMEP**	**3**	Seecon International GmbH	SEECON	Switzerland	**1**	**24**
CR	**SMEP**	**4**	Bioazul S.L.	BIOAZUL	Spain	**1**	**24**
CR	**SMEP**	**5**	Lammin Paja Ky.	LAPA	Finland	**1**	**24**
CR	**SMEP**	**6**	Bauunternehmen Weixlbaum GesmbH	WEIXBAU	Austria	**1**	**24**
CR	**RTD**	**7**	Universitat Kässel	UNIK	Germany	**1**	**24**
CR	**RTD**	**8**	Tampereen Teknillinen Yliopisto	TUT	Finland	**1**	**24**
CR	**RTD**	**9**	Verein zur Förderung des Technologie Transfers an der Hochschule Bremerhaven e.V.	TTZ	Germany	**1**	**24**
CR	**RTD**	**10**	National Institute of Public Health – Statni Zdravotni Ustav Praha	SZU	Czech Republic	**1**	**24**

Table D23-1: Contractors list

Contact details of the co-ordinator

Mr. Roland Meingast
natur & lehm Lehmbaustoffe GmbH
Oberwaltersdorferstrasse 2c
A-2523 Tattendorf
Austria
Phone: +43 (0) 225 38 10 30-0
Fax: +43 (0) 225 38 10 30-18
E-mail: r.meingast@lehm.at

Work Performed, Results Achieved So Far and Expected End Results

The aim of the PLASTER+ project is to develop, to test and to optimise a high quality innovative and cost effective healthy indoor earth plaster reinforced with cattail fibre, and besides to develop and to test a highly technical automated prototype plant with minimum maintenance, which dramatically will make better the production process of common earth plasters in order to improve the competitiveness of earth plaster products on the national and international plaster market.

Therefore, several workpackages have been proposed in order to achieve the above mentioned objectives:

- WP 1. Determination of requirements
- WP 2. Design, construction and installation of the prototype components
- WP 3. Research and optimisation of the PLASTER+ production
- WP 4. Exploitation and dissemination
- WP 5. Project management and co-ordination

During the first 12 months of the project duration, reporting from May 15th 2006 until May 14th 2007, the market requirements for the PLASTER+ product were determined, as well as the potential production of cattail in Europe. In addition, prototypes functional and technical requirements were specified (WP1). These determinations would be the basis for the further design of technology.

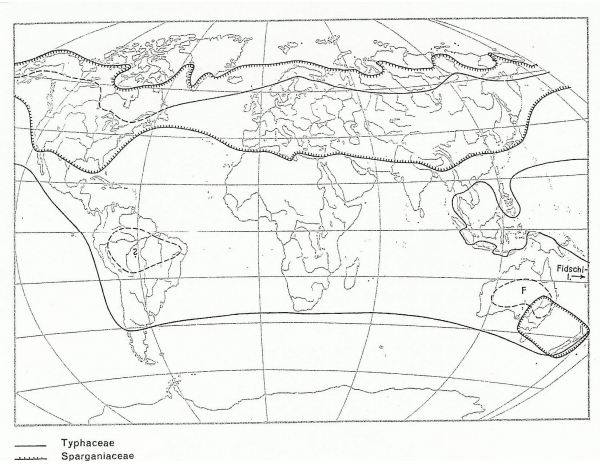

Fig. D23-2: Distribution area of Typhacea (cattail) and Spargariaceae

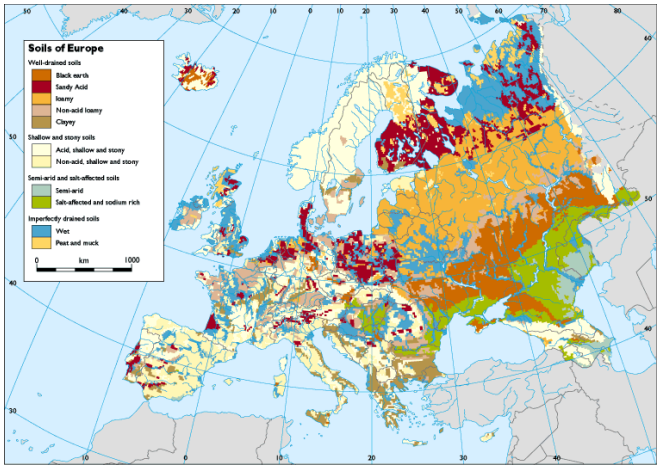

Fig. D23-3: Soils of Europe (EEA 1995), showing the abundance of drained soils were cattail can be cultivated

Based on the knowledge acquired in WP1, the main aim of WP2 was the design, construction and installation of the PLASTER+ prototypes components. Therefore, both cattail preparation and earth plaster production prototype plants were designed and their construction plans and descriptions were established. Based on this, the prototype plants components were planned to be constructed, transported and installed in order to start with the initial tests.

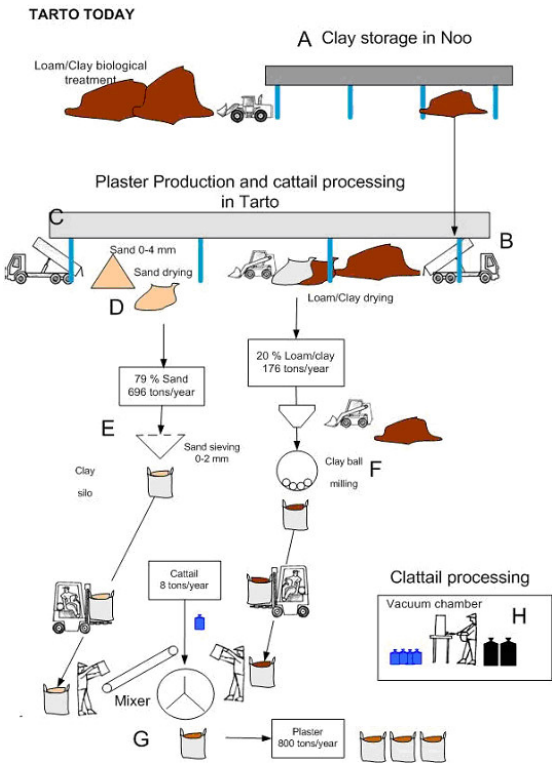

Fig. D23-4: Plaster and Typha fibre processing in Tartu

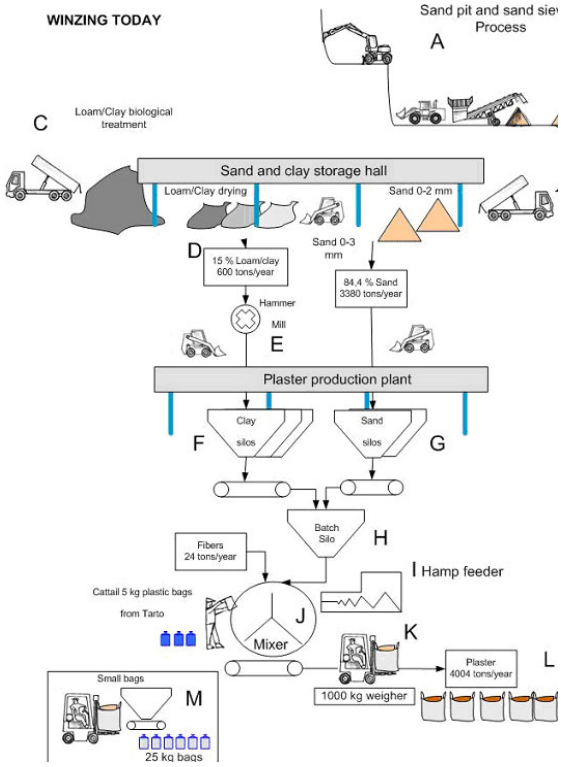

Fig. D23-5: Winzing Plaster process diagram

Within the second reporting period, reporting from May 15th 2007 until August 14th 2008, and taking into account the conclusions extracted from WP1, the consortium finalised WP2, whose main objective was the design, construction and installation of the PLASTER+ prototype components.

The change in the prototype concept from two separated prototypes for cattail fibres separation and PLASTER+ production respectively to one unique modular and transportable production unit for PLASTER+ material meant an inflection point for the project. This new prototype was designed, and its construction plans and descriptions were established. Based on this, the prototype plant components were constructed and immediately transported and installed in order to start with the initial tests.

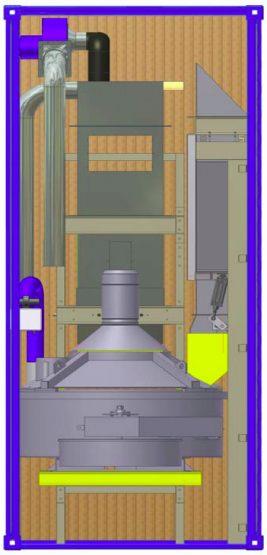

Fig. D23-6: Prototype design: "1100 AB Mixing Container" Mixing container including: 20 feet open top container, mixer, hopper, fibre feeder, ultra sonic fog producer and air blower

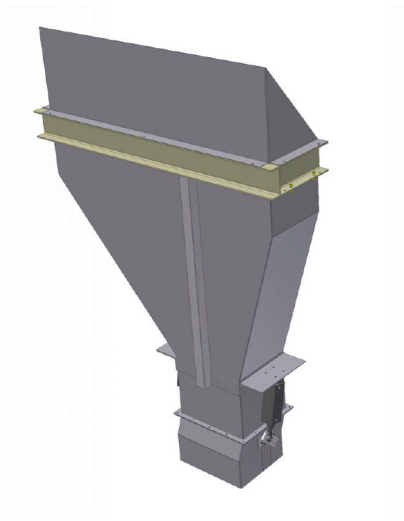

Fig. D23-7: Prototype design: "P01-01 Hopper" Sand and loam batch silo (=hopper) with sand guide, frame, silo and hatch opening cylinder

Fig. D23-8: Prototype components: mixing container with hopper, torn loose, right

Fig. D23-9: Prototype installation: mounting containers of prototype in Krems harbour terminal

WP3, whose main objective was the research on the optimisation of the PLASTER+ production, was also carried out. After finalising the transportation and the installation of the prototype, and solving all problems arisen within these processes, the prototype was finally run, using ready milled clays bought from industry. The target figure was to create a similar system as it is used in concrete production for temporary supply of big building sites.

Fig. D23-10: Clay-silos and green fibre mill

Fig. D23-11: Prototype final appearance

Cattail quality parameters were measured and assessed, concluding that cattail fibres gave poor living conditions for fungi and were therefore of good quality. Fibres also showed a good and uniform dispersion.

Fig. D23-12: Feed with cattail fibres

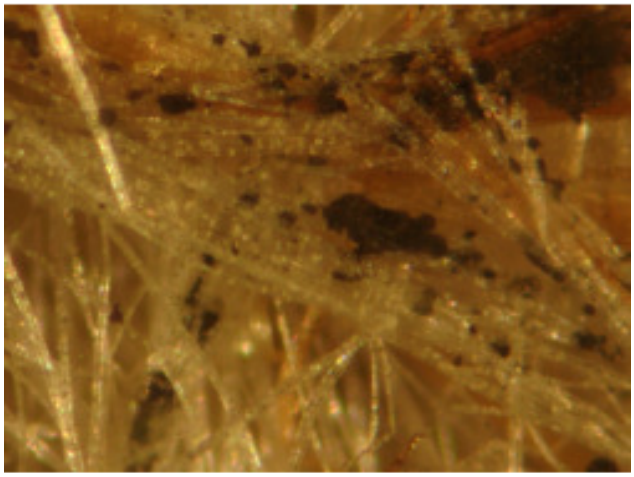

Fig. D23-13: Fungi growth behaviour analyses

Quality of the ready PLASTER+ product (standard and additional quality parameters) was also measured and assessed, especially taking into account the analysis on the mould sensitivity of the PLASTER+ dry mixture and the reusability and the biodegradability of the plaster material. PLASTER+ product was characterised as a biodegradable material after studying it under different percentages of humidity, with what the material lose weight. It could be re-used without loosing its technical performance. Furthermore, it could be used as an additive for compost, although this process only made sense for small remaining plaster materials from cleaning up.

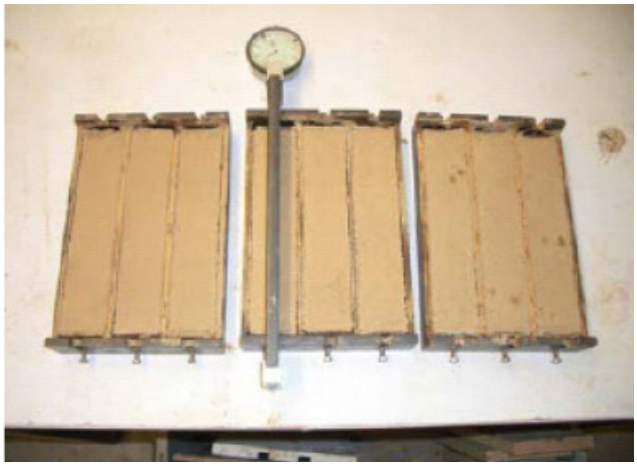

Fig. D23-14: PLASTER+ material shrinkage test

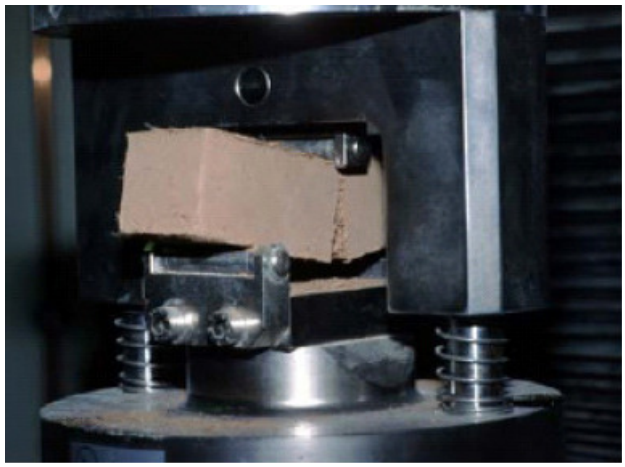

Fig. D23-15: PLASTER+ material tensile bending test

Fig. D23-16: PLASTER+ material abrasion test

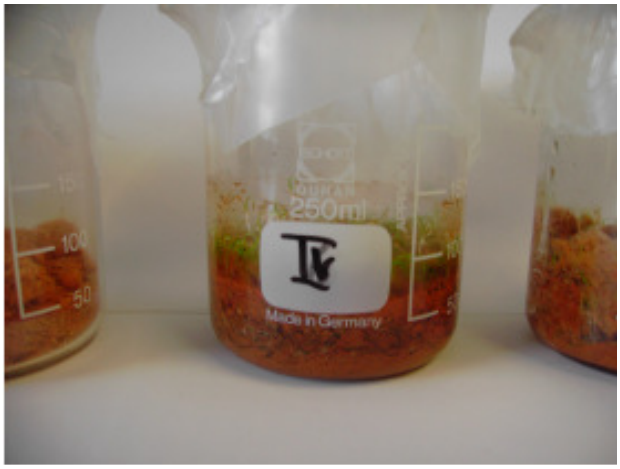

Fig. D23-17: PLASTER+ biodegradability test

Finally, the effects and potential risks of the cattail fibres and the new PLASTER+ material for human health were also evaluated, focusing the attention in the performance of tests such as microbiological safety, chemical analysis of the content of toxic metals, cytotoxicity in cell cultures for the estimation of toxicity potential for human body tissues, and screening dermatological tests to prove compatibility of materials with healthy human skin. On the basis of the clinical studies, good skin tolerance and indoor suitability of the tested material even for persons exhibiting skin hyperreactivity, e.g. allergy or skin atopy, can be expected. The results of the studies confirmed the claim for the tested material, i.e., hypoallergenic material. Under the test conditions the tested material PLASTER+ material - cattail fibres did not elicit immediate nor delayed type of allergy reactions (type I allergy, type IV allergy).

Strong dissemination activities were carried out within WP4 since the beginning of the project in order to widespread to a major public the main outcomes of the project.

One of the main tools for the wide dissemination of the project and its results was the development during this first year of the official project website, **http://www.plasterplus.info**, launched in August 2006. It consists of a public access site containing a description of the project and the PLASTER+ product, information about the objectives, partnership and progress of the PLASTER+ project, photographs and useful links, and a restricted access site for the consortium partners in which all important information, project deliverables and other documents are hung down. The website was updated during the whole duration of the project. Additionally, all partners were gradually introducing references about the PLASTER+ project in their own websites. It has been also continuously updated as stated in the Technical Annex with information about the progress of the PLASTER+ project, including information about the achievement of objectives, deliverables submission, meetings etc.

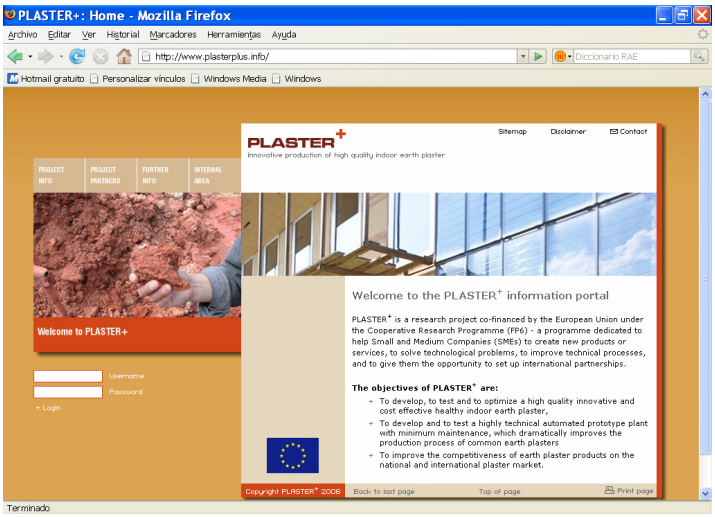

Fig. D23-18: PLASTER+ webpage - Home

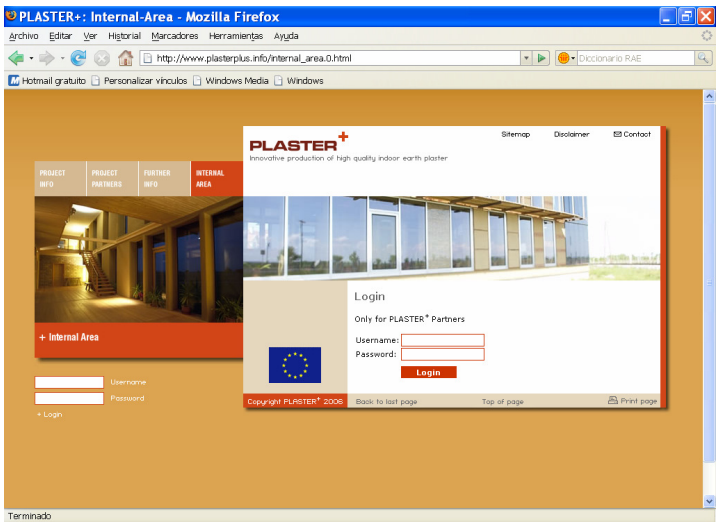

Fig. D23-19: PLASTER+ webpage – Internal area

The official project poster and the official project brochure were developed as well. The files of this dissemination material were distributed amongst the partners in order to help them to create awareness about the project in conferences, seminars, exhibitions, etc.

Fig. D23-20: PLASTER+ official poster

Fig. D23-21: PLASTER+ official brochure – front

Fig. D23-22: PLASTER+ official brochure - back

Other dissemination activities, i.e. preparation and presentation of diffusion material like brochures, posters and papers were carried out by all partners, as well as press releases, attendance to conferences and meetings, and the introduction of the project to relevant stakeholders and authorities. The most remarkable activities were the following:

- Publications in relevant magazines.
- Presentations at trade fairs related to construction, lifestyle, healthy living.
- Direct contacts to relevant associations, consultants, manufacturers and distributors in the construction and agricultural sector.
- Demonstration of the PLASTER+ prototypes to potential other plaster or cattail fibre producers. The demonstration schedule for the system was developed after performing the planned tests and process optimisation.
- Inclusion of the project in the CORDIS database and website.

Fig. D23-23: PLASTER+ poster developed by TUT

Fig. D23-24: Part of the PLASTER+ consortium presenting the project in the Bauma exhibition

A more detailed explanation of the dissemination activities carried out, as well as several routes for the exploitation actions agreed to date regarding the results, are available in the "Plan for Using and Disseminating the Knowledge".

The management of the project (WP5) was carried out in parallel to the research activities during all this time, ensuring the correct coordination, communication and cooperation between the partners.

The PLASTER+ project officially started on May 15th, 2006, and it was launched during the Kick-Off Meeting in May 29th – 31st, 2006, held at the general co-coordinator's N&L facilities in Tattendorf, Austria. Since then, the project has been managed by the three coordinators, N&L (being the general and financial coordinator), TTZ (the scientific coordinator) and BIOAZUL (the administrative coordinator), as it was expected without problems with a strong highly efficient team work that has ensured a fluent communication and information transfer within the consortium.

In addition to daily management activities, several extraordinary activities were carried out during the first year of the project. A periodic report on the distribution of the EC's contribution was submitted due to the first distribution of the advance payment among the partners, as well as a supplementary report (six months report presented in November 2006). In addition to daily management activities, a technical meeting was held in November 22nd – 23rd, 2006, being hosted by TUT and LAPA in Tampere, Finland.

The midterm meeting was held in June, 13th – 14th, 2007 at CPS facilities in Tartu, Estonia. During that meeting the activities carried out within the first project period were discussed and further reported to the EC. These activities were described exhaustively in the first periodic reports which were submitted to the EC on June 28th, 2007.

Once more, several extraordinary activities were carried out during the first months of the second project period. After finishing the first reporting period, the 70% of the advanced payment provided by the EC at the beginning of the project was not spent, therefore the consortium did not receive a second payment. That is why it was decided to request to all partners their additional cost statements and submit them to the Commission in December 19th, 2007, when the 70% of the advanced payment had been already spent. These cost statements covered the first six months of the second reporting period, i.e., since May 15th, 2007 until November 14th, 2007.

An important extraordinary management issue was solved within this period. Due to the decision of changing the design concept and constructing only one unique modular and transportable production unit

for PLASTER+ material instead of two separated prototypes for cattail fibres separation and PLASTER+ production respectively, the consortium was forced to adapt the workplan to the new requirements and to take the decision of requesting a project extension to the EC, which was further conceded. .

Additionally, two technical meetings were held on July 5th, 2007 in Tampere, Finland and on 17th – 18th March 2008 in Lammi, Finland, where technical solutions for the problems arisen were discussed.

The final meeting was held in Krems, Austria by 21st – 22nd July, 2008. the prototype was installed in this location. The activities corresponding to the second project period and the final project results were discussed within this meeting and further submitted to the EC in the second periodic reports and the final project reports.

The following table summarises the workpackages in which the consortium has worked during the project:

WP no.	Workpackage title	Lead-contractor Short name	Start month	End month	Deliverable / Milestone	Status
WP1	Determination of market and technical requirements	CPS	0	4	D01-D03 / M1	✓
WP2	Design, construction and installation of the prototype components	TUT	3	16	D04-D06 / M2-M3	✓
WP3	Research and optimisation of the PLASTER+ production	N&L	6	24	D07-D12 / M4-M5	✓
WP4	Exploitation and dissemination	SEECON	0	24	D13-D18 / M6	✓
WP5	Project management and co-ordination	N&L	0	24	D19-D23 / M7	✓

Table D23-2: Workpackages list of the PLASTER+ project

The partners of the consortium have been working on the tasks foreseen and the results have been achieved as expected. The work carried in the PLASTER+ project should not stop now; it should be the basis for other activities in the future.