

Fibre + project

First project report

May 2014

The project has come completed its first period of execution and the second period is currently in progress.

The main objective and integrated output of Fibre+ project is to create an innovative process based on the modification of recovered fibres, to produce new functional packaging products with high level of standardization in the EU. This will reduce the sector's need for virgin fibres and support the competitiveness of packaging SMEs in the EU. This will be achieved by:

- the study and development of potential treatments for recovered fibre modification capable of improving physical- mechanical properties of recycled papers
- selecting the best fibre modification treatments based on property and recyclability criteria and validating at pilot plant scale
- developing appropriate modification process systems of recovered fibres, exploring new possibilities for both cost reduction and quality increase in packaging design and manufacturing with the input of all stakeholders
- implementing, demonstrating and validating a pilot plant for fibre modification (energy and raw material efficiency).The plant will be completed with the assistance of SME consortium members
- training staff members of all the participants and disseminating the results to interested packaging SMEs (organizing training courses and technical seminars, publishing in practical sector journals and brochures and using the internet)
- identifying new uses of enhanced modified fibre papers by comparing existing technologies and the results of Fibre+ technology in corrugated packaging SMEs
- fostering the implementation of the new innovative fibre modification technology in SME users

It is foreseen that the project will help identify the industrial bottlenecks of paperboard SMEs and to establish a channel for them to express their interests and specifications for the new innovative modification process of recovered fibres with criteria of performance and optimisation. The consortium will create a database of characteristics and properties on representative fibre raw materials and products (recovered fibres, grade papers, corrugated board, boxes) for packaging companies throughout Europe.

A description of the work performed since the beginning of the project and the main results achieved so far can be summarised as follows:

- Actual SME industrial bottlenecks and expectations on the specification of Fibre+

The industrial bottlenecks (supply problems, limitations in processing of recovered fibres, product's quality failures, manufacturing and productions needs etc.) of the European paperboard packaging SMEs were identified by using a questionnaire, CEPI and FEFCO reports and their members' reviews. This information was used for specifying the Fibre+ technology. According to this specification, Fibre+ technology should:

- Improve the chemical-physical-strength properties of recovered fibres
- Keep or improve paper recyclability (repulpability, increasing of number of recycling cycles)
- Follow a priority in treatments: stock preparation, size press, combination
- Provide possibilities to apply treatments off line (batch treatment) and/or on line (during paper production process)
- Provide cost-effective treatments
- Provide paper products which comply with the food contact legislation

Fibre+ technology should not:

- Decrease paper strength properties despite the shortening and hornification of recovered fibres
- Decrease paper machine efficiency/productivity
- Change significantly process water conditions (pH, conductivity, cationic demand, COD)
- Increase energy consumption
- Increase manufacturing costs by using expensive chemicals for the treatments
- Negatively impact the sustainability of the papermaking process, effluents, and safety

- Industrial practices in utilizing recovered fibres

Published information and industrial practical know-how relevant to recovered fibres available for the European paper industry was analysed. This was achieved through an extended literature review as well as through surveys and visits to SMEs. The existing documented and published information relevant to recovered fibres available for the European paper industry was gathered, analysed and referred to sources, types, quality and characteristics, quantities, availability, handling by companies, uses in different products, effects on product's performance, etc. Furthermore the different types of fibres used for the different products have been summarised and a specific review has been carried out, taking into account the current state of the art of fibre modifications. The following were taken into consideration: type of modifications, methodology for the modification, chemical,

mechanical and enzymatic treatments, improved properties and improved products, applicability, etc. Also, the industrial practical know-how and experience regarding the recovered fibres by the European paper sector was gathered through direct visits to SME installations and by the experiences and support of the SME groupings of the consortium (CEPI, FEFCO). Significant conclusions were drawn on the potential to process recovered fibres and useful suggestions were made for the project:

- Fibre modification should preserve fibre and paper properties with lower costs as compared to today's costs. Costs have more importance than improvement of properties
 - Fibre modification should not add to costs and. Special attention needs to be paid to costs of treatments vs final products price
 - Fibre modification should be easily adapted in the production line
 - In case the quality of certain fibres is improved, it will be possible to use lower quality fibres
 - Fibre modification chemicals should be better added in the stock preparation phase as many paper mills in Europe do not have size press or other devices to dose the chemicals on the formed sheet
 - Fibre modification technologies should take into account the sequence of dosage in relation with its integration with other chemicals used during stock preparation
- Go/no-go decision, selection of modification agents and methods of delivery, and standards to evaluate effectiveness

Appropriate modifying agents fulfilling the SME requirements and specifications of Fibre+ technology were selected, methods of delivery (submersion in water, spraying) to the recovered pulps were evaluated, and standards to compare the effectiveness of the modifications on the fibre and paper properties were defined. Specifically, a list of modification agents and respective methods of delivery as well as a list of standard methods to evaluate the effectiveness of fibre modification methods were presented. The selection of optimum agents (go/no-go decision) on agents and modifications was based on the properties of handsheets manufactured by using modified fibres, with the condition that recyclability was not hampered.

- Industrial adjustment of selected fibre modifications to the recovered fibrous materials from SMEs

The best performing modifications were further studied and enriched to achieve the industrial adjustment needed for the pilot plant stage in the next steps of the project. Recycled pulp was provided by an SME paperboard company of the consortium and was characterised by its stock properties (ash, fines, etc.) and fibre characteristics (qualitative-quantitative analysis, and MORFI). Twenty one (21)

adjustment trials of modification parameters for the representative recycled pulp, referred to the modification agent, method of application etc., were used for a first screening. The results of this first screening were used to optimise the industrial adjustments in a twofold modification approach, wood and paper based. After testing both approaches, the paper based modification was selected and further screened for industrial related parameters and tests. The data on the final chemistry specifications were used to assist the pilot plant design phase and also to prepare two research articles on fibre modification at peer reviewed journals of the sector.

- Fibre+ mapping and assessment of production processes at a selected SME

Detailed characterization and critical assessment of the state of the processes in a paperboard SME of the consortium was performed, including on-site mapping of material flows in stock-preparation and in the approach flows, raw material utilisation, energy mapping and potential effects of the introduction of a Fibre+ concept.

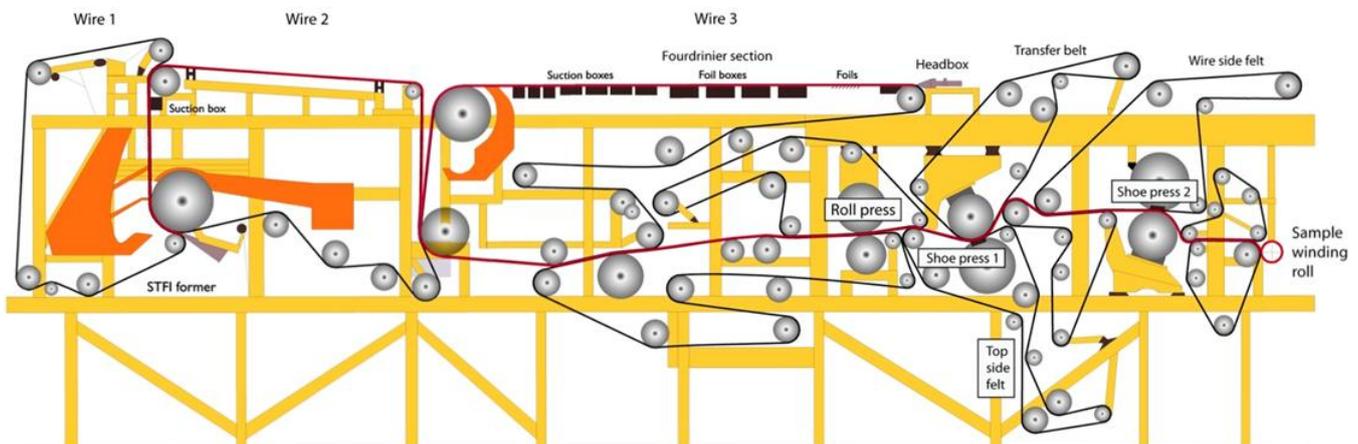
- Budget and detail design for generic Fibre+ system

This involved a detailed description of a generic Fibre+ handling system based on the results from previous lab-scale testing of modification agents. The selected chemicals were to be added to pulp suspension in an approach system of the paper machine at the dosage position(s) that ensures the best conditions for the reaction between chemicals and fibres and thus the resin efficiency. Adding dry or wet strength agents is to be decided based on the composition of the raw material. The performance of any additives depends on how well it is retained on the fibre. The efficiency of wet-strength and dry-strength resins is influenced by charge level in the stock, pH, content of mineral salts and anionic contaminants, temperature, fines and filler content and other additives. The resin adsorption process is more rapid and complete at higher consistency (thick stock) because the polymer molecules have shorter travel distance before colliding with a fibre surface. In order to achieve an even resins spreading, it is important that very good mixing occurs at the point of addition on the paper machine. Only a very rough estimation of the budget for a generic Fibre+ handling system could be made.

- Budget and detailed design for demonstration for a selected mill

A design of the Fibre+ concept at the selected SME and a suggestion for demonstration trials to be performed at INNVENTIA on the pilot paper machine FEX were presented. The Fibre+ concept implies the strengthening of testliner using wet and dry strength agents. The proposed chemicals are to be added to pulp suspension in an approach system of a paper machine. At present, the mill does not use any paper chemicals but the introduction of starch is planned in the near future. For the mill, the Fibre+ concept includes introducing new chemicals and

installing the chemical handling system. Before introducing this kind of chemicals, an environmental impact assessment has to be made. The goal for the trials on FEX is to demonstrate that by using the suggested chemicals, testliner properties can be improved. The trials will be performed using a Fourdrinier forming section at the lowest possibly machine speed. Paper with a grammage of 100 g/m² will be produced. Paper rolls from the mill will be used as a raw material. The chemicals will be handled according to safety data sheets. There are several environmental considerations in connection to Fibre+ demonstration trials at FEX. Residual chemicals, broke produced during trail and process waters have to be handle in an environmentally way.



A principal overview of the FEX paper machine at INNVENTIA

- Installation of the Fibre+ demonstration at the FEX pilot plant

A first reference trial was performed in pilot scale. The purpose of the demonstration facility is to provide a set-up for the validation of the Fibre+ process concept and to prepare the work field of industrial implementation during the next steps. The following trial points were produced: (1) reference without chemicals (2) reference with starch, 3 levels of dosage (3) reference with commercial c-PAM, 3 levels of dosage.

- Testing of modified pulps and paper products from the pilot plant trials

The results on the first reference trial showed a small increase in paper strength when starch was used. No effect was obtained using a commercial c-PAM.

- Additional alternative and reference chemicals tested in new/extended activities to enable a pilot plant implementation

A new set of extensive laboratory testing for the selection of chemicals is being carried out. The aim is to compare alternative and reference chemicals at the same conditions to enable pilot plant implementation based on the Fibre+ concept.

The Fibre+ project, via the implementation of an innovative process based on modification of recovered fibres, aims at supporting the competitiveness of the SMEs in the packaging sector in Europe. The project is expected to have a direct economic benefit for paper and packaging manufacturing SMEs of the sector through a twofold approach:

- More economic and sustainable packaging
- Achievement of target paper properties with fewer materials

Improving the performance and functionalities of packaging materials clearly opens new possibilities for both cost reduction and quality increase in packaging design and manufacturing. It is expected that many other European and global enterprises will be interested in this technology, which ensures quality of production and reduce of material costs. Applications of Fibre+ in a European and global dimension and expected licences/ agreements thereafter ensure a sound investment of the SME-AGs and REA funds.

The economic impact of Fibre+ technology for the SMEs of the sector in Europe will be evaluated in detail within the development of the project by using the Business Impact Assessment Tool created by CEPI.

Optimised packaging improves the quality of life by enabling products to be supplied with safety, in an affordable and environmentally sound manner. The project results focus on the technical and economical quality of the most important packaging material (corrugated board) and thus contribute to this perspective of packaging. The more effective utilisation of recycled waste paper fits well with the EU policies on improving the quality of life of the consumer society.

The corrugated packaging industry also belongs to the EU Forest-based industries. They constitute one of Europe's largest industrial sectors, providing employment and income to some 2.6 million people directly and accounting for around 10% of the European manufacturing industry's total value of production, value added and employment.

Developing modern packaging products with improved, functional and standardised characteristics helps strengthen the position of paper as raw material in the field of packaging. In addition, it contributes to a better use of recycled paper and its fibres.

This results in a higher ecological value and a greater protection in the European forests as a whole.

List of partners:

Name	Short name	Type of activity	Country	Web address
CONFEDERATION DES INDUSTRIES PAPETIERES EUROPEENNES CEPI AISBL	CEPI	SME Association/ Grouping	Belgium	www.cepi.org
EUROPESE FEDERATIE VAN FABRIKANTENVAN GOLFARTON IVZW	FEFCO	SME Association/ Grouping	Belgium	www.fefco.org
TECHNOLOGICAL EDUCATIONAL INSTITUTE OF THESSALY	TEILAR	RTD Performer	Greece	www.teilar.gr
GEORG-AUGUST-UNIVERSITAET GOETTINGEN STIFTUNG OEFFENTLICHEN RECHTS	UGOE	RTD Performer	Germany	www.uni-goettingen.de
UNIVERSIDAD COMPLUTENSE DE MADRID	UCM	RTD Performer	Spain	www.ucm.es
INNVENTIA AB	INNVENTIA	RTD Performer	Sweden	www.innventia.com
CENTRALNY OSRODEK BADAWCZO-ROZWOJOWY OPAKOWAN	COBRO	RTD Performer	Poland	www.cobro.org.pl
RAPINA PABERIVABRIK	ASRPV	SME participant	Estonia	www.rappin.ee
PARGIANAS NIKOLAOS & CO EE	NTL	SME participant	Greece	www.ntl-chemicals.com
DS SMITH PACKAGING ITALIA SPA	DSSPaperIT	Other enterprises or end-users	Italy	www.dssmith.uk.eu

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