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**CIP Eco-innovation
Pilot and market replication projects
Call 2008**

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**Interim Report
Project Erutan
Contract ECO/11/304532**

**Covering the reporting period from
01/12/2012 to 31/12/2014**

Reporting Date

<30/01/2015>

Project coordinator: Best Wool Carpets B.V.

Project website: www.ERUTAN.eu



1 Progress of work plan in the period

1.1 General progress

During the first 23 months of the project the scouring process was further optimized for production. During this optimization phase together with Dawson a discussion started about the size of air bubbles in order to further enhance process effectiveness, energy consuming and lead-time. In the beginning of 2014 this led to the introduction of aeration generating tiny air bubbles and turbulence in the process. The trials on production scale with ordinary air bubbles was planned for March 2014, but the further development of the bubbles into micro air bubbles led to the postponing of these trials. An extra set of trials on lab scale in order to optimize production variables came apparent and these were performed in September, October and November 2014. During these trials the different variables such as temperature, process time and amount of natural degreasing agent, for the three different scouring stages in production were optimized and the process was released for production.

In February 2015 a series of production scale tests were performed in collaboration with Dawson at Ariete in Gambino, Italy. The tests showed that the quality of the wool was comparable with the quality of conventionally washed wool, the process used less energy, but the process times were longer and a problem with the initial wetting of the wool became apparent.

Based on the outcome of the production scale tests, and the fact that the price of lanoline has devaluated in such a way in the last years that it's no longer interesting to harvest and sell lanoline from the process, the consortium has decided that at this moment it's not viable to invest in a production plant in western countries. An investor is now sought for the realization of a smaller, cheaper scouring plant that can be built up in a less developed country.

One thing that came very apparent during the project was the process enhancing capacity of the micro air bubbles. This process enhancing capacity will further be investigated in the dyeing of yarn, in collaboration with Danspin and Dawson.

With regards to optimization of the carpet bonding paste for industrial production, two different approaches developed in parallel by UPC and James (JMS) have been explored. Advantages and drawbacks of both adhesive pastes – lignin-based and linseed oil-based led to optimization strategies to combine both approaches and improve the formulations and consequently the adhesive performance. By means of these investigations the current adhesive paste meeting the quality requirements is a combination of both approaches.

Deliverable 3.3 – Optimized for industrial production paste composition was achieved. Although the developed paste meets the performance requirements, the consortium is continuously trying to lower its final price in order to further facilitate market uptake of the carpets.

In the meantime BWC has continued the extension of her premises to create a production area for the backing line as such. The construction started in March 2014 and is planned to be finalised in February 2015.

1.2 Progress on all work packages against initial objectives

WP1: Management

All objectives that were due until the end of this reporting period have been met.

The Project Management Guide was completed in M6 (D 1.2).

The project website and Project Information Sheet has been up-dated in M19 (D 1.1) and uploaded to our website. Next website update is planned for M27, in relation to the Grant.

The Progress Report after 10 months (D 1.3) was in time and approved.

The Interim Report after 18 months was in time but not approved, because of the delay in Work Package 2, related to the wool scouring. A request for amendment was done by the consortium, which led to the postponing of the Interim Report to M25, reporting progress until M24.

WP2: Up-scaling of the enzymatic wool scouring

In the summer of 2013 the consortium contacted H. Dawson Sons & Co Wool Ltd. (Dawson). Dawson showed interest in ERUTAN's scouring process and through Dawson the consortium was introduced to Manifattura Ariete (Gambino, Italy) – an independent commission wool scouring company. James, BWC and Dawson visited the production-side in November 2013 in order to analyse whether their scouring line would be suitable for carrying out large-scale trials and easily adaptable to the ERUTAN process. During the visit it was determined that the scouring machine of Ariete is suitable for the intended use and large scale trials were agreed to plan.

In the meanwhile the scouring process was further optimized for production. During various in-depth discussions between James, BWC and Dawson the size of the air bubbles used in the process was challenged. Especially since the size of the air bubbles could enhance process effectiveness and production time.

In March 2014 this led to the introduction of aeration generating tiny air bubbles and turbulence in the process. For this purpose a small aeration air generator was rent from the supplier performing small scale trials in Grubbenvorst. The results were that much encouraging that further trials were scheduled and executed.

In March 2014 the wool scoured on lab-scale according to the process with the initially introduced air bubbles and enzymes was tested at AgResearch. The wool was whiter than conventionally scoured wool with detergents and bleaching agents at high temperatures.

It was planned to perform trials with the air bubbles on production scale in March/April 2014. These trials, however, were delayed due to further time needed for discussions between the consortium and Dawson about the size and amount of air bubbles for scouring. This discussion and further research led to the development of micro air bubbles, with better performance in terms of process time as well as cleanness and whiteness of the scoured wool.

This refined technology was checked with the patent lawyer and confirmation was received that it falls within the existing patent position ERUTAN has.

To produce the right size and amount of micro air bubbles for the scouring plant in Italy three pumps as well as other material to adjust the machinery was ordered. The pumps arrived in Grubbenvorst early July 2014 to do larger scale trials before planning the trials in Italy.

To optimize all production variables many additional trials were performed in September, October and November 2014 all in close partnership with Dawson.

During these trials the different variables such as temperature, process time and amount of natural degreasing agent, for the three different scouring stages were optimized and the process was released for production.

After the successful trials the consortium had hoped to perform the trials on production scale in December 2014, realizing D 2.1, D 2.2 and D 2.3 all at once and catching up with the delay. Unfortunately, Ariete did not have any capacity until the week commencing February 16th 2015.

During this process Qualizyme was responsible for the supply of appropriate amount of the enzyme product QZ 2002 for the wool scouring pilot trials. QZ 2002 – a formulation of alkaline proteases for the bio-bleaching of sheep wool was produced in larger batches with improved protocols.

In April 2014 new and faster immobilization method for the enzymes used in the formulation was developed, providing good results on wool, and making it possible to reduce the steps during the immobilization process down to the finished enzyme end product.

For the improved formulation protocol a carrier that is an anionic copolymer based on methacrylic acid and methyl methacrylate was applied. This solid substance in form of a white powder is also used in pharmaceutical products as well as food industry and was consequently well suited to be applied in carpets without any health risks for the customers. In lab trials we worked with this carrier and alkaline proteases. In a stepwise reconstruction of the old process with an acidic and an alkaline buffer system we were able to bring the process to a one-step immobilization method using only a neutral buffer system with pH 7.

This one-step immobilization procedure for the creation of the QZ 2002 enzyme product was applied in three subsequent batch production cycles and proved to be reproducible. With this method the required time for immobilization was reduced by more than 50% and chemical consumption for buffer production by roughly 12 % leading also to reduced costs of protease immobilization. With this new procedure the production of QZ 2002 in amounts suitable for industrial application was achieved.

A film of the scouring process using micro bubbles is up-loaded to the ERUTAN web-site.

After realizing so much the consortium is disappointed that the lack of capacity in the scouring line caused the further delay, not realizing *D 2.1 – 100 kg of wool washed in 1 day (M10)*, *D 2.2 – 1.000 kg of wool washed in 1 day (M15)* and *D 2.3 – 1.000 kg of wool washed in 8 hours (M25)*.

The fact that the trials have been planned for the week commencing February 16th 2015 gives an outlook of actually catching up with the delay. A separate report on D 2.1, D 2.2 and D 2.3, related to the wool scouring, will therefore be send in before the end of March 2015.

Purchase of equipment

James purchased 3 Nikuni pumps KTM32N of 2.2Kw. with Rotary Trading company for use at the trial plant in Grubbenvorst and then at the scouring line in Gambino, Italy.

More small parts as well as pressure vessels have been ordered to be able to install the pumps. All materials will be transported to Italy early February after which James, BWC and Dawson will be present to install the equipment, make the necessary small amendments to the production line and do the trials as well as the production-run.

Subcontractors/stakeholders

We are pleased that H. Dawson Sons & Co Wool Ltd has become a partner of the ERUTAN process. We signed a non-disclosure agreement as well as a joint development agreement to protect the interest of ERUTAN's IP. The persons involved are Jo Dawson (CEO/Owner) and David Halley (Global Product Director).

We are pleased that Manifattura ArieteS.r.l. has become a partner for ERUTAN through Dawson's, providing the ability to use their equipment for industrial scale up. The person involved is Claudio Pasini (CEO/Owner)

We are pleased that we found AgResearch Limited available to do testing on scoured wool as well as comparison with current scouring results. The person involved is Steve Ranford (Senior Scientist).

WP3: Up-scaling of the adhesive composition and enzymatic bonding of carpet layers

Achievements

The objective of WP3 is the up-scaling of an enzymatic process transforming natural based compounds (e.g. plant phenolics) into an adhesive capable to replace synthetic latex and to make wool carpets 100 % recyclable.

Providers for the adhesive precursors and enzymes have been identified and their supply guaranteed (D3.1 and D3.2). The paste composition has been defined for carrying out pilot scale trials. As stated in Progress Report 1 (M10), the consortium has focused its efforts on combining two approaches simultaneously developed at UPC (adhesive generation from lignin and natural phenolics cross-linked with laccase enzyme) and JMS (cross-linking of epoxidized linseed oil). The combination of both approaches was aimed at overcoming the intrinsic brittleness of lignin relying on the flexibility of the linseed resin. At lab scale, the manual dosing of the lignin-based paste alone on the carpets lead to thick coatings that initially masked the brittleness problem. However, the trials carried out in the pilot line at the beginning of the project using a roll-based method for paste deposition revealed the necessity of a plasticizer, though the bonding strength of the adhesive was satisfactory. The work carried out under tasks 3.3 and 3.4 brought about a natural-based plasticizer solution consisting in the use of epoxidized linseed oil. Combination of both approaches using the pilot line located at JMS facilities led to carpets with improved flexibility, reduced powder release upon extensive carpet use and a bonding strength above 35 N (the minimum bonding strength accepted for tufted carpets is 30 N). In this lignin-linseed oil-enzyme formulation, the enzyme activates and phenolates the lignin before mixing with the rest of the ingredients and is still active when the paste is applied on the carpet (the paste composition is detailed in D3.3). Consequently, the step necessary to carry out the enzymatic reaction on the pilot line was eliminated, shortening the whole process. The paste is applied to the carpet and the carpet goes directly to a short 15 min drying step at 95 °C where the activity of the enzyme is boosted to a maximum.

The price of the current paste formulation has been reduced from ca. 7,- €/m² to ca. 4,25 €/m² after the removal of some expensive components present in the initial paste composition – implying a variation of the ratio of the rest of the ingredients. Though reduced, this price is still substantially higher than latex. Working with non-bulk reagents (in some cases experimental batches) that are not widely commercialized for the purpose of adhesive production justifies this elevated in comparison to latex price. Nevertheless, the benefits of the formulation are

accumulated over the whole supply, production, and recycling chain, and should be regarded in terms of: i) full recyclability, ii) eco-efficiency, iii) low energy consumption (the process is carried out at up to 95 °C, while latex is cured at above 150 °C), and lower transportation costs of the lighter carpets (latex is normally 70 % of the weight of the carpets, or about 1 kg/m², while our paste is only 500 g/m²).

Purchase of equipment

So far no equipment has been purchased since all larger trials were done at the pilot line in Grubbenvorst, which was available at the start of the program.

Other trials have been done at a trial production line from Lacom Vertriebs GmbH. Lacom is our partner to co-develop and build the full width backing machine. First trials on their line have been done in August 2014 (pictures attached). The results of these trials were disappointing compared with the trials done at the pilot line in Grubbenvorst.

This has led to further discussions with Lacom about the production line and renewed plans will be discussed.

First costs are expected after Best Wool Carpets has finished its extension of the factory to create floor space for the backing machinery, which is due in February 2015.

Involved partners and their roles:

The project partners BWC, JMS and UPC are involved in this work package. Whereas BWC will take care of the production of ERUTAN-backing and carpets, JMS and UPC are working on the optimization of the adhesive on the pilot line at JMS facilities.

Subcontractors/stakeholders

BWC has subcontracted IM-aces in order to contribute to the development and up-scaling of the paste. IM-aces is a technology and an innovation acceleration centre. Its added value can be found in different segments of technology and at any stage of innovation. We work together with Kees Weterings, a retired expert with proven references during his career, in his own field of expertise. Kees Weterings advises the group in how to extract lignin from potato peels and to mix the right components together in order to achieve the best results.

One of the stakeholders within WP3 is Duynie from the Netherlands. At Duynie Holding, part of the international group Cosun, everything revolves around the processing of organic by-products from the food industry in the best possible way. It is a continuous challenge to find new, better and smarter applications for the raw materials. Duynie's approach has proven its success and the company has grown into a versatile group with a wide range of activities operating under their own brand names in specialised market segments. Consequently, Duynie Holding evolves in a different way to its primary competitors. Duynie developed an extraction method for lignin from potato peels together with JMS and IM-aces. Persons involved are Ir. Derk van Manen (Manager QNR), Dr. Ir. Mike Litjens (Manager R&D) and Eric Bals (Sales and Marketing Manager).

Another stakeholder and supplier of the ERUTAN-paste is Hobum from Germany: HOBUM Oleochemicals was founded 1959 as Hamburger Fettchemie Brinckmann and Mergell GmbH. As former subsidiary of an oil mining and refining plant, the basic idea of this company was to develop new products based on vegetable oils and fatty acids for technical applications. Until today the company is processing renewable raw materials into very specialized oleochemicals

and additives for the chemical industry. Top Quality products from HOBUM Oleochemicals are the basis for further developments and successful applications in various fields of the chemical industry world-wide. HOBUM supported JMS in the development of the paste based on epoxidised linseed oil and provides not only the linseed oil but also the hardener. Persons involved are Dipl. -Kfm. Arnold G. Mergell (Geschäftsführer), Renate Polster (Geschäftsführerin), Dipl.-Chem. Dr. Michael Blumenstein (Forschung und Entwicklung), Dipl. -Chem Dr. Jens Lüttke (Forschung und Entwicklung), Lutz Kämpfer (Anwendungstechnik).

Supplier of the backing machinery will be LacomVertriebs GmbH. This company is specialized in the most modern laminating machinery. The special way of laminating the paste as developed by ERUTAN can be built by Lacom in existing laminating technology.

This will enable us to make good progress once the paste has its final recipe.

Persons involved are Dipl.-Kfm. Techn. Jürgen Kiener (General Manager), Dipl.-Ing. Achim Schalle (Sales Director) and Steffen Kühn (Project Manager)

WP4: Life Cycle Analysis of ERUTAN

No deliverables were planned for this work package yet.

WP5: Exploitation and Business Plan

D 5.1 – Business Plan version (M3) was finalized in M16. D 5.2 – Business Plan version 2.0 (M6) was finalized in M19.

D 5.3 – Exploitation report version 1.0 (M18) is postponed until M28, after the trials at Ariete.

WP6: Dissemination Activities

Project Information was updated in M19 of the project and made available on the web-site. This was originally planned in M12 (D 6.1).

The next project information update is planned for M28, after the trials at Ariete.

Regarding D6.6, the publication of scientific papers, the following progress can be reported:

- Aracri E, Diaz Blanco C, Tzanov T. An enzymatic approach to develop a lignin-based adhesive for wool floor coverings, Green Chemistry. 2014, 16 (5), 2597 - 2603.
- Article in Chemistry World Magazine - edited by the Royal Society of Chemistry <http://www.rsc.org/chemistryworld/2014/02/carpet-lignin-adhesive-soil-fertiliser>
- Article in C&EN News edited by the American Chemical Society: http://www.cendigital.org/cendigital/20140303?sub_id=BFRUFsfr4EGaH#pg41

Besides scientific papers the following oral contribution to international congresses has been done:

- Aracri E, Diaz Blanco C, Tzanov T.

Development of a lignin-based adhesive for wool floor coverings using laccase and natural phenols
 IPFB2014 - 8th International Conference on Polymer and Fiber Biotechnology
 25-27 May 2014
 Braga, Portugal

- Aracri E, Diaz Blanco C, Tzanov T.
 Laccase-catalysed functionalization of lignin to produce a novel, bio-based adhesive for wool floor coverings.
 International Conference on Biobased Materials and Composites, ICBMC'14
 13 – 16 May 2014
 Montréal, Canada

Deliverables

Del. N ^o 1	Deliverable name ¹	Type ¹	WP N ^o 1	Delivery date from Annex I ¹	Delivered (yes/no) and status (draft/final)	Submission with report ²	Forecasted delivery date	Comments on progress
D1.1	Project website and up-dates	Website	1	M3, M15, M27, M36	Yes (final, with regular up-dates)	PR1	M19	Web-site is up-dated continuously, last update M 19
D1.2	Project Management Guide	Report	1	M6	Yes (final)	PR1	M6	
D1.3	Interim report after 18 months	Report	1	M10	Yes (final)	PR1	M10	
D2.1	100 kg of wool washed in 1 day	Report and test	2	M10	No	PR1	M24	Scheduled for M27
D2.2	1.000 kg of wool washed in 1 day	Report and test	2	M15	No	-	M24	Scheduled for M27
D2.3	1.000 kg of wool washed in 8 hours	Report and test	2	M24	No	-	M24	Scheduled for M27
D3.1	At least 3 adhesive precursors as per yarn and backing material selected	Technical description	3	M6	Yes (final)	PR1	M6	-
D3.2	Supply of adhesive precursors and enzymes guaranteed	Report	3	M6	Yes (final)	PR1	M6	-

Del. N°1	Deliverable name ¹	Type ¹	WP N°1	Delivery date from Annex I ¹	Delivered (yes/no) and status (draft/final)	Submission with report ²	Forecasted delivery date	Comments on progress
D3.3	Optimized for industrial production paste composition	Technical description	3	M12	Yes (final)	-	M18	Although the developed paste meets performance requirements, the consortium tries to lower its final price in order to further facilitate market uptake of the final product.
D5.1	Business Plan version 1.0	Report	5	M3	Yes (final)	IR1	M17	
D5.2	Business Plan version 2.0	Report	5	M6	Yes (final)	IR1	M19	
D5.3	Exploitation Plan version 1.0	Report	5	M18	No	-	M23	Delayed until M28, after trials in M27
D5.4	Long-term stable pricing structure for wool	Report	5	M18	No	-		Delayed until M28, after trials in M27
D6.1	Project Information Updates (pre-defined)	Text, ppt	6	M1, M12, M24, M36	Yes (final)	IR1	M19	Delayed until final development of micro air bubbles
D6.2	Inputs to additional common information material related to eco-innovation actions	Input to posters, articles for newsletters, visuals, interviews	6	On request by EASME	No	-	-	
D6.3	Project-presentations (pre-defined)	Ppt, presentation, participation in events	6	Upon request	No	-		
D6.6	Publication of scientific and technological papers	Publications	6	Upon request	Yes (final)	IR1	M18	
D6.7	Preparation of (commercial) brochures and flyers	Flyers	6	Upon request	No	IR1	M28	New flyers and brochures will be issued in M28, after the trials at Ariete
D6.8	Communication and or visiting of international fairs	Visits	6	M2, M14, M26	Yes (final)			

(addressing target group)							
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¹ This information must be identical with your List of Deliverables in Annex I of your Grant Agreement.

²Please indicate the report with which you have submitted the deliverable (PR1, IR, PR2,...).

1.3 Identified deviations, problems and corrective actions taken in the period

WP	Deviations and encountered problems	Mitigation of the problem
2	No new scouring machine was built due to financial difficulties with the external financial party, due to general economic conditions in Europe.	The partnership with Dawson was enhanced from wool supplier to full Erutan partner. Together we found the scourer Ariete willing to adjust their machinery for industrial production according to the new Erutan scouring process.
2	Deliverable D 2.1, D 2.2 and D 2.3 are not achieved in time.	The realisation of D 2.3 - 1.000 kg of wool washed in 8 hours was planned for December 2014, but delayed due to lack of capacity at Ariete. The trials are therefore postponed until the week commencing February 16th 2015. When the results are according to planning final adjustment of Ariete's machinery will take place resulting in a continuous operational process in May 2015. With this deliverable D 2.3 - 1.000 kg of wool washed in 8 hours will be achieved.
3	Pilot scale trials with the enzymatically-generated adhesive demonstrated its brittleness upon extensive usage of the carpet. The brittleness of the adhesive translates into unacceptable powder generation. Such effect is caused by the intrinsic brittleness of the lignin adhesive precursors additionally cross-linked by the oxidative enzymes. Normally, excessive crosslinking, although providing high bonding strength (2-3 fold higher than the standard), results in higher brittleness.	<p>To overcome the intrinsic brittleness of the lignin-based adhesive, the inclusion of external (not reacting with lignin) and internal (reacting with lignin) plasticisers have been exploited. Additionally, enzymatic pre-treatment for pre-activation of lignin introducing in its structure of smaller size natural phenolics expected to induce flexibility was assayed. Although, improving the flexibility the phenolation of lignin was still not sufficient to overcome the brittleness.</p> <p>In a second approach, natural-based epoxidized linseed oil plasticizer has been used. The combination of lignin and epoxidised linseed oil led to high bonding strength and lack of brittleness.</p> <p>Furthermore, the linseed oil adhesive has been also developed as a back-up, low-cost approach for carpet backing.</p>

3	High for large-scale production price of the natural adhesive	Eliminating some of the most expensive ingredients of the lignin-based adhesive. Incorporation in the adhesive formulation of up to 50 % low-cost epoxidized linseed oil. Alternatively, development of a low-cost adhesive based on 100 % epoxidized linseed oil. Shortening of the backing process by 30 min, translated in lower energy costs
3	Deliverable 3.3 was delayed due to the above problems	D3.3 was achieved using optimized for performance and price adhesive formulations containing: 50 % lignin + 50 % linseed oil (enzymatic approach) 100 % epoxidized linseed oil

1.4 Progress regarding performance indicators

The goal to market 2.37 million m² of ERUTAN carpet on a yearly basis is postponed for at least one and a half year. This means that the performance indicators as indicated in Annex II of the Grant will be reached one and a half year later than intended at the start of the project. ERUTAN thinks this is justifiable seeing the developments during the project which led to the further improvement of the wool scouring process.

2 Progress regarding market uptake and exploitation

Uptake of the scouring process

With the changed position of H. Dawson within the ERUTAN process we have gained a strong partner that is very willing to roll out the new technology in all parts of the world. The scouring process is expected to be operational for industrial production later in 2015. In this year, it's intended that, at Ariete, 0.25 million kilogram of wool is scoured according to the ERUTAN scouring process.

For 2016 new machine(s) will be build (or adjusted) and together with Ariete this will be good for a minimum of 2 million kilogram of wool scoured.

In 2017 ERUTAN intend to further roll the technology out in other parts of the world which will be good for 10 million kilogram of wool scoured.

Together with H. Dawson we will investigate the opportunity to build small, low costs scour lines made out of plastic instead of steel that can be used in farming communities around the world.

Sheep farmers currently are getting a low price for their wool because it is a raw product that further needs to be processed.

When these communities are able to offer an end product through the sales network of H. Dawson they will enable to get better prices and ERUTAN will get more traceable and pesticide wool.

To protect the interest of ERUTAN we have secured the patent in the most important wool markets.

Dawson has showed a strong interest to agree on a license.

Our partner Danspin has lately invested a lot in their hank-dyeing facilities. After this is finished they will be interested as well to look into the scouring machinery of ERUTAN.

Uptake of the backing process

ERUTAN's carpet backing process will be operational in 2016. Due to the delay in finalizing the paste and bring its pricing down to acceptable commercial levels discussions with Desso and Lantal have been delayed. The backing trials in August at Lacom were crucial for further technical development of the industrial machinery and since these were not sufficient additional time is required to engineer the equipment.

Best Wool Carpets will finish the construction of the new building in February 2015 after which the exact size of the space available is known.

Further discussions and negotiations between BWC and Lacom will have to take place during the first half of 2015 to secure the finale set-up and lead-time of the machinery.

The installation of the equipment is scheduled for February/March 2016 after which Best Wool Carpets can start producing carpet.

In 2016 Best Wool Carpets intends to produce 250.000m² carpet finished with the ERUTAN backing technology.

Once the machinery is operational Lantal intends to starts with its first 100.000 m² carpet finished with the ERUTAN backing technology.

In 2017 the planning is to produce 2.0 million m² of ERUTAN carpet by Best Wool Carpets, Lantal and Desso, who will join as soon as the machine is operational and all small changes have been done.

In 2018 it is planned that these three manufacturers produce 5.0 million m² of ERUTAN carpet together.

3 Work plan for the next period

3.1 Planned activities in the next period

WP2: Up-scaling of the enzymatic wool scouring

During the week commencing February 16th 2015, trials will be done on the production line in Ariete. During these trials we will work on a single step approach to combine all necessary processing steps.

Upon successful trials, the wool scouring line will be adapted for the ERUTAN process in May/June 2015. With this, deliverable *D2.3 – 1.000 kg of wool washed in 8 hours (M24)* will be achieved.

In parallel, Qualizyme will continue to strive for further reduction of cost and improvement of the enzyme-based product with regards to the immobilization procedure. For this quality, automation and implementation at large scale will be investigated. In parallel, our standard assay procedures to monitor product quality are currently being simplified. Moreover we will test the new protease product on a pilot line designed at James B. V. Optionally, the enzyme

carrier can be replaced by cheaper alternatives to further reduce the cost of the enzymatic scouring product QZ 2002. Intensive collaboration of Qualizyme with partners James and Best Wool Carpets will be continued.

WP3: Up-scaling of the adhesive composition and enzymatic bonding of carpet layers

The plant where the backing line will be situated is under construction.

Pictures of the future plant are up-loaded to the website. The new processing line in this new built plant is expected to be operational by February/March 2016 (M41). With this, *D 3.4 – Industrial scale-up of the pilot backing line* will be achieved with a 16 months delay against original planning (M24).

WP5: Exploitation and Business Plan

The Exploitation plan will be drafted after the trials and production in February in Italy have been finished.

3.2 Planned meetings, activities related to market uptake and dissemination activities

Planned meetings / activities	Date
Discussions with Lacom about development of backing line	Ongoing
Set up Exploitation report version 1.0, check for template	March 2015
Issue new flyers and brochures, Grubbenvorst, The Netherlands	March 2015
Convert the scouring line of Ariete to the Erutan scouring process	May 2015
Production plant at Best Wool Carpets is ready	February/March 2015

4 Other issues

The consortium has failed to do the official requests for amendment of the Grant regarding the following topics:

- With the departure of Dr. A. Paar from Qualizyme his responsibilities have been transferred to H. Pobeheim of Qualizyme.
- With the departure of the responsible expert at TNO an alternative was found in IM-Aces. Therefore it was decided to transfer the activities planned in WP2 and WP3 from TNO to IM-Aces.
- With the departure of C. Kempchen at James and the hiring of A. Severijn at Best Wool Carpets some management tasks were transferred from James to Best Wool Carpets.

It was forgotten to turn in these requests when the Interim Report after 18 months was not approved. The consortium will turn in these requests soon as possible.

5 Overview on hours spent

Please find an overview of the hours spend during M1 until M24 of the project in Annex A.

6 Financial report

Please find the financial report covering project period M1 until M24 in Annex B.