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PROJECT FINAL REPORT

Grant Agreement number: 609203

Project acronym: ECOGEL-CRONOS

Project title: *'High productivity manufacturing process of composite parts based on zero emissions fast curing coatings and heated moulds'*

Funding Scheme: Collaborative Project FoF. NMP.2013-10**.**

Date of latest version of Annex I against which the assessment will be made:

20/11/2015-Amendment III

Period covered: **from** September 2013 **to** August 2016

Name, title and organisation of the scientific representative of the project's coordinator[1]:

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

1. Final publishable summary report

1.1. Executive summary

ECOGEL CRONOS project aims to develop an innovative and high productivity Resin transfer Moulding (RTM) process by means of the use of i) fast curing "zero VOCs emissions" powder gel coats[3] and ii) electrically conductive hot skin mould technologies based on laminates made of carbon-fiber- plastics (CFP laminates) to mass production parts for automotive and transport sector (agricultural equipment and good transport).

Different resin modifications have be done to: i) improve developed powder gel-coat adhesion to different resins such as epoxy, vinylester or urethane acrylate ii) to develop conductive gel-coats for mould construction and iii) to improve the thermal resistance (up to 200ºC during long time) of the epoxy resins using in the manufacture of hot skins. Preforms have been used during manufacturing process. It is assessed the influence of preforms in cycle time reduction and it is concluded that this contributes to reduce cycle time drastically by means of automatization processes. Simulation programs were used to determine RTM mould design and electrical threshold in conductive powder gel coat formulation. Finally, powder gel coat formulations (non-conductive and conductive) were obtained and electrically heated technology was used to manufacture demonstrator moulds.

Two products, representatives of the advantages of this new production line, have been developed within the project as demonstrators: a fully finished agricultural equipment part and a composite automotive part ready for e-coating bath painting treatment **successfully demonstrating powder gel coat technology** for non-conductive formulation. Minor adjustments are needed for the conductive powder gel coat formulation**. Electrically heat technology was successfully demonstrated for simple parts,** being necessary further adjustments for complex ones.

Figure 1. ECOGEL two case studies

MAIN IMPACTS

- **Cost reduction is demonstrated when using ECOGEL materials and skin technology**
- **Using non-conductive powder gel-coat in place of the conventional, liquid gel-coat could reduce the emission of VOCs by a factor of 30**, eliminating styrene emissions coming from gel coat in the workplace. Further development are necessary in the non-conductive powder gel coat formulation.
- **Introduction of new materials which are environmentally friendly**.

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[3]Liquid gel coat contains high styrene contents and hazardous catalyzer and has long polymerization time (up to 1 hour).

1.2. Project context and objectives

Composites have emerged as a valuable class of engineering materials because they offer many attributes not attainable with other materials. Light weight, coupled with high stiffness, and selectable properties have fostered their use for many years in satellites, high performance aircraft and world class sailboats. Now, these materials demonstrate their worth in the equally demanding consumer, infrastructure, automotive and sporting goods areas. However, the transition to many of these mass demanding sectors is being slow, primarily due to low productivity rate for cost-efficient manufacturing.

Nowadays, transport and automotive industry is facing increasingly stringent environmental regulations which lead to increase the power-to-weight ratio of the cars reducing the overall weight and thereby reducing vehicle emissions. To achieve this goal, composites are a key technology but they must meet weight, cost and production rate requirements. While traditional composites used in automotive industry have typically utilised high cost aerospace-derived prepreg technology for autoclave curing or Sheet Moulding Compound (SMC), ECOGEL CRONOS focuses on Resin Transfer Moulding (RTM) to provide unparalleled efficiency in terms of cost and production rate with the same performance and quality.

In this context, **ECOGEL CRONOS project aims to develop an innovative and high productivity Resin transfer Moulding (RTM) process** by means of the use of i) **fast curing "zero VOCs emissions" powder gel coats** and ii) **electrically conductive hot skin mould technologies** based on laminates made of carbon-fiber-plastics (CFP laminates) to mass production parts **for automotive and transport sector** (agricultural equipment and good transport).

Objectives of the project	*Degree of Completion (%)*
1.Development of a **full range of powder gel coats that will reduce film time from hours to a few minutes** and **eliminate the styrene emissions** in a production plant of composite parts. **- no further handling** will be made prior its application to the hot mould. **- full elimination of initiators** in the plant of composites parts such as methyl ethyl ketone peroxides or heavy metal is a key advantage to the introduction of these materials. This means **zero VOC emissions in the formulation and freedom from hazardous components**.	90 (1)
2. **Development of a polyester curing reaction initiated by temperature** that leads to a robust process independent of the environmental conditions. This will lead to reduce significantly the quality problems of current liquid gel coats such as low curing degree, pin-holes, warpage, gloss, etc. that require an accurate formulation of catalyser and initiator in function of environmental processing conditions	100
3. The powder gel coat will have **excellent stability at room temperature and long self-life (higher than one year). Easy to transport and to store**.	100
4. **Power gel coat effective yield in grams per square metre of a powder gel coat is always higher than that of a liquid gel coat (approximately 1:4).** Additionally, the gel	100

coat will react with the resin used in the injection unit forming a chemical interface and, consequently, obtaining unbeatable adhesion properties between the gel coat and the injected resin at any time after film formation, whereas liquid gel coat, requires to achieve a "tacky state" to get a good interaction interface between gel –coat and resin injected.	
5. **Decrease in raw materials consumption.** Unlike liquid coatings, the easy, clean and safety powder spraying gel-coat application based on electrostatic paint system can be recovered by vacuum systems and re-used without any major difficulties. This feature brings about further savings in the application and costs per moulded part.	100
6. Research into additives and carbonous fillers for powder gel coats which will endow the cured coating with an **adequate superficial electrical conductivity** for a subsequent **automotive E-coating bath painting treatment**. This type of technology is potentially very interesting because it can contribute to manufacture affordable plastic parts suitable for the e-coat process used, mainly, in the automotive sector and competing directly with metal parts.	90 (1)
7. To manufacture a **fully agricultural equipment part**, which will be released from the mould, trimmed and ready to be assembled without any further finishing. This is very enticing for transport part makers due to the fact that **eliminate the necessity of secondary painting** which is an expensive operation and sensitive to quality defects.	90 (2)
8. The development of injection resin formulations (based on vinylester and epoxy) that will **enhance compatibility between powder gel coat and laminated part improving chemical interfase** and thereby the quality of the finish composite.	100
9. Introduction of **affordable heated moulds for high production rates**. This will include the fabrication of mould skins, moulds and counter-moulds. The "skin" will be designed and manufactured with metallic or metallic-like (conductive) coatings to allow electrostatic power gel-coat deposition and electrically conductive laminates made of carbon-fiber plastics (CFP) to heat the powder gel coat until reach gel coat film formation temperature. **Efficient temperature control elements** will be also introduced to optimize energy consumption.	90 (2)
10. **New epoxy resin** with high temperature resistance (up to 200ºC during long time) will be used. The use of **high glass transition temperatures (Tg)** will ensure low wear out of the tool's surface resulting in a longer working life of the tools. It is predicted that this technology will enlarge at least two times the current working life of existing tools.	100
11. The implementation of a **fibre preforming unit** will effectively reduce fibre waste by 20%. This operation also removes the need for bulky fibre cutting tables and cutting equipment resulting in reduction of workshop floor space. Additionally, **research in binders to be used in the fibre preform** will be accomplished to assure the best compatibility between resin and fibre preform.	100
12**. Cost reduction per part could be estimated as much as 25%,** taking into account the reduction in material cost and processing cost, as table 1.1.2 shows. The calculation is based on a part with 10 kg weight and 1 m^2 surface. Costs are collected from commercial products and our estimated costs based on the expertise of ECOGELCRONOS partners (INDUPOL, ECOINNOVA and CLERIUM).	100

13. **New high performance 2K hybrid adhesive** based on chemical join polyurethane and epoxy groups that permit a suitable integration of developed coated composites parts with metallic parts or other composite parts.	100

(1) Conductive powder gel coat electrical conductivity property, storage stability, adhesion and curing time is in line with ECOGEL targets. However, film formation is not good enough to apply final coating. Additionally, when conductive powder gel coat emissions were analysed, it was found that, although VOCs emissions are reduced when compare with liquid gel coat emissions and styrene emissions are completely removed, some benzene emissions appears. Then, conductive powder gel coat formulation should be adapted to improve film formation and remove benzene emissions.

(2) The shape of the Lely part was a challenge to get a homogeneous heating applying electrically heated technology proposed in ECOGEL project. Although, powder coating technology was successfully demonstrated on small moulds and on AXON mould demonstrator obtaining parts with no shrinkage, good cure and proper demoulding some pre-release problems were faced on INDUPOL mould demonstrator due to hot spots areas in the mould. However, based on the results obtained within the project further development will be completed to take advantage of the high potential of thin, interchangeable, heated tooling skins on the market.

According to this objectives reached within the project, the main innovations claimed in **ECOGEL CRONOS** are:

- An **innovative RTM production process** has been developed by means of the **introduction of powder gel coat and new mould technologies** to obtain cost-effective products and high production rates **for automotive and agricultural equipment industry** as well as enlarge composites applications in other mass production sectors. **Door skin was obtain with a fully finished non-conductive powder coating successfully demonstrating the powder coating technology. Powder gel coat technology has been successfully demonstrated with non-conductive formulation in the door skin manufacturing.**

- An **accurate control mould skin temperature** has been developed and implemented in order to obtain a film from the powder gel coat with the minimum energy cost. Moreover, **mould temperatures** in the whole production process should be **closely monitored** in order to ensure the highest level of efficiency in average moulding cycle times. **The electrically heated mould technology is successfully demonstrated for nearly plain designed parts.** To investigate further the potential of thin, interchangeable, heated tooling skins can bring many benefits within composites production processes so this opens the possibility of new developments in order to be able to design complex parts.

- **Development of resin and binder formulation** to improve powder gel-coat, reinforcement and different polymeric resin compatibility **optimizing product quality thanks to a true chemical interface formation,** including a **polyurethane/ epoxy group's hybrid adhesives** for power gel coat coated parts integration.

- A three components hybrid adhesive was formulated and tested demonstrating a good performance comparing with current adhesives used in composites sector.

- Epoxy, vinylester and urethane acrylate resins have been modified in order to optimize resin-powder gel coat interaction. Best results regarding adhesion (pull-off test) between modified resins and powder gel coat are obtained with urethane acrylate resin modified with coupling agents (adhesion increases almost double if compared to unmodified resin) and vynilester modified with coupling agents (increased by 60% compared to unmodified resin).

- Powder gel-coat produce **better quality finish than current ones** without a follow finish process.

- **Better quality** (improved UV resistance, good film formation, good chemical resistance and) **was demonstrated in non-conductive powder gel coat formulation** compared with liquid gel coat.

- **Conductive powder technology is a promising technology to be used as a primer for electro stating painting** in the composites sector for future hybrid metal-composites parts. Although parts with good quality are obtained in electrostatic painting lines using conductive powder gel coat as a primer, further work should be devoted to adapt this formulation taking into account e-coating and electro stating painting process parameters.

- **Cost reduction is demonstrated when using ECOGEL materials and skin technology. Material costs** for coating 1 m2 with powder gel coat are **24,6% lower** than coating with liquid gelcoat**.** New concept of RTM mould **skin system based on carbon fibres heating technologies is an ideal option** when production volume is as high as 20 000 pieces. **Labour costs per part** when using Ecogel-Cronos materials **will be reduced by approximately 62%** when compared to conventional materials and processes. To sum up, it can be concluded that Ecogel materials and removable skins has clear advantage for Axon, at least 15% costs benefit is reached. Utilization of removable skins allows for Axon to automise the process and reach the TAKT time they require. The same statement is valid for Indupol when the volume of 1000 is reached.

- **Higher effective yield of powder gel coat is demonstrated**. Specific gravity of the powder is around 1,6 g/cm^3 and the spreading rate (or application yield) for 0,15 mm. dry film thickness is about 4,1 m^2/Kg; so for a 0,15 mm. layer applied over 2m^2 of the mould surface we will need aprox. 0,490 Kgs of the powder gel coat, which is a 74% less of powder needed to coat the same part area as with the liquid gel coat.

- Furthermore, the use of gel coat as, as a conductive primer, will eliminate the need for subsequent surface finishing phases (degrease and painting phases), this means a **significant reduction in chemical products and energy.**

- **Introduction of new materials which are environmentally friendly** (eliminate styrene emissions and harmful operating materials such as peroxides, additives and catalysts in the composites parts manufacturing). **Moreover, the oversprayed powder gel coat can be recovered and reused reducing waste.**

- **Using non-conductive powder gel-coat in place of the conventional, liquid gel-coat could reduce the emission of VOCs by a factor of 30**, eliminating styrene emissions coming from gel coat in the workplace. Further development are necessary in the non-conductive powder gel coat formulation, so VOCs emissions should be evaluated again when conductive adapted formulation was ready.

1.3. Main scientific and technological results and foregrounds

The work in the project has been structured in nine work packages, arranged as shown in figure 2.

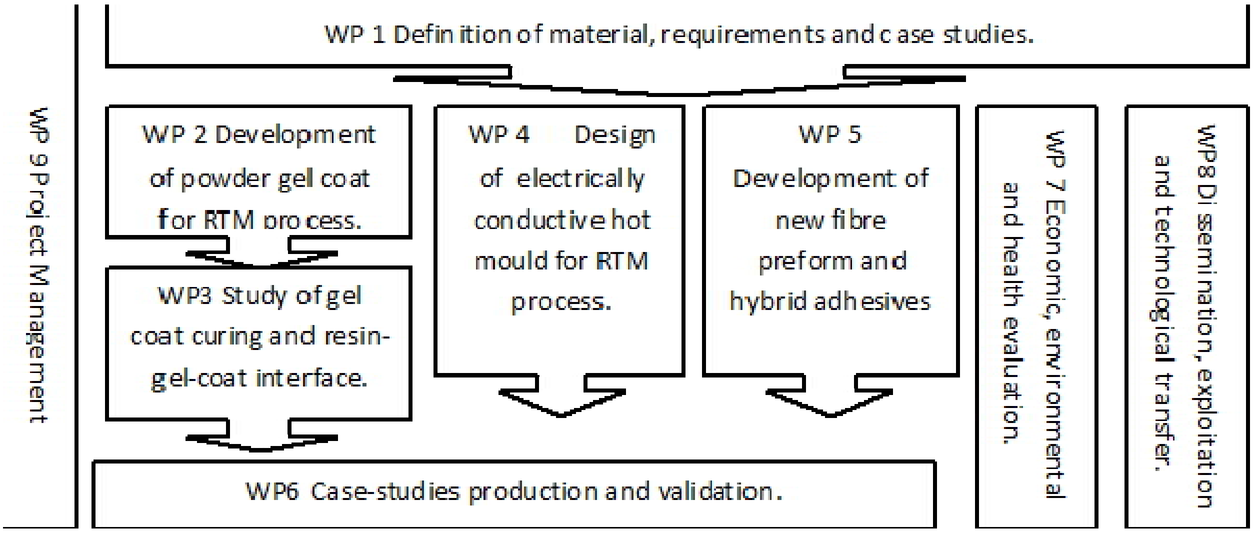


Figure 2. Graphical Presentation of the Project.

PARTNERS´ LIST-for reference

Please find below the final partners´ list, according to ***Amendment III***.

Beneficiary Number *	**Beneficiary name**	**Beneficiary short name**	**Country**	**Duration (months)**
1(coordinator)	ASOCIACIÓN DE INVESTIGACIÓN DE MATERIALES PLÁSTICOS Y CONEXAS	AIMPLAS	ES	1-36
2	STEEL BELT SYSTEMS SRL	SBS	IT	1-36
3	COMPOSITE INTEGRATION LTD	CI	UK	1-36
4	CLERIUM	CLERIUM	NL	1-36
5	INDUPOL INTERNATIONAL N.V.	INDUPOL	BE	1-36
6	AXON AUTOMOTIVE LIMITED	AXON	UK	1-36
7	NETCOMPOSITES Ltd	NETCOMPOSITES	UK	1-36
8	E-XSTREAM ENGINEERING SARL	E-XSTREAM	LU	1-36
9 (former)	FACHHOCHSCHULE DORTMUND	DUASA	DE	1-6
9 (new)	FACHHOCHSCHULE BIELEFELD	FHBI	DE	7-36
10	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	ECOINNOVA	ES	1-36
11	Teknologiakeskus KETEK Oy	KETEK	FI	1-36
12	FUNDACION CIDETEC	CIDETEC	ES	1-36
13	VIOMICHANIA RITION MEGARON ANASTASIOS FANIS ANONYMOS ETAIRIA	MEGARA	GR	1-36

Partner #6-AXON has a Third Party linked to them within this project, i.e. FAR-UK, since March14.

The main scientific and technological results achieved are the following, presented in a WP per WP basis.

WP1 - DEFINITION OF MATERIALS, REQUIREMENTS AND CASE STUDIES.							
Participant	AIMPLAS	SBS	CI	CLERIUM	INDUPOL	**AXON**	NETCOMP
	EXTREAM	DUASA	ECOINNOVA	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES:	WORK PERFORMED:
The main objectives of this work package were: - To define the essential requirements needed for improving RTM process by means of new mould technologies and powder gel coat development. - To compile a data base of suitable raw materials to be used throughout the project for tool making, resin-binder and resin-powder gel coat compatibilization as well as for compounding of powder gel coats. - To select at least two products demonstrators that could be more representative of the advantages of new RTM process technology such as a fully finished agriculture equipment part and a composite automotive part ready for E-coating bath painting treatment.	**Description of work** This work package is divided into the following tasks: Task 1.1 In-depth analysis of existing production equipment technologies. Task 1.2 Listing a suitable raw material data base for compounding, binders and tooling. Task 1.3 Market and trend analysis of the coated RTM case study. Task 1.4 Case study selection and determination of specifications. Task 1.5 Detailed project planning and Risk indicators.
COMPLETION DEGREE (%)	The objective was 100% successful from the technical point of view.

RESULTS
In this work package, an **in-depth revision of industrial RTM process technologies, raw materials suitable for electrically heated mould technology** (resins and conductive gel coat), **components for the new powder gel coat formulation** and **additives to improve compatibility between gel-coat-resin and resin-binder** was accomplished. An extensive **market analysis on agricultural equipment and automotive components**, their production volumes, coating requirements, etc. was completed. Finally, the **demonstrators to be produced within the project together with a complete revision of automotive industry and agricultural equipment requirements were fulfilled**. The case studies were selected: LELY Splendimo PC330 mower (figure 3) and a door skin for an automotive manufacturer (figure 4). Sales quantity were defined and specifications were based on DAF and Bentley requirements.

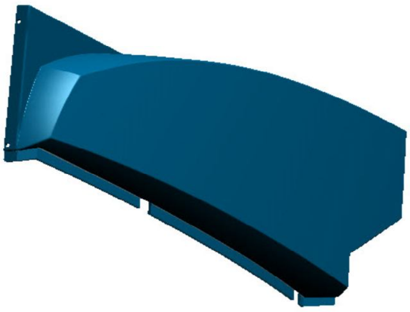


Figure 3..CAD image LELY agricultural equipment part.

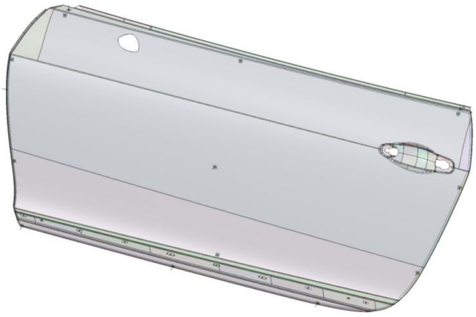


Figure 4. CAD image of door main skin

A **detailed project planning** was defined and revised each six months to define the responsibilities and the timing for each task within ECOGEL project. '**Risk Indicators Table'**, was a working 'live' document updated by the Coordinator, AIMPLAS, with the feedback received by each WP leader, from the beginning to the end of the project.

CONCLUSIONS
Baseline for the project was defined and was used to compare results obtained with ECOGEL RTM process including powder gel coat and electrically heated mould technologies developed within the project.

WP2 DEVELOPMENT OF POWDER GEL COAT FOR RTM PROCESS.							
Participant	AIMPLAS	SBS	CI	CLERIUM	INDUPOL	AXON	NETCOMP
	EXTREAM	DUASA	**ECOINNOVA**	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES:	WORK PERFORMED
The WP2 was devoted to the study of powder gel coat formulations and its adaptability to the RTM production environment foreseen. It also included potential alterations on chemistry as well as optimum polymerisation kinetics of the coating.	This work package is divided into the following tasks: Task 2.1 Registry of powder gel coat formulations and suitable ingredients. Task 2.2 Modification on chemistry and curing kinetics of powder gel coats. Task 2.3 Development of electrically conductive powder gel coats. Task 2.4 Adaptation of modified formulas to the RTM production.
COMPLETION DEGREE (%)	The objective was 100% successful, from the technical point of view. First formulations were selected in order to complete pilot plant applications in WP3.

RESULTS
The preparation of different unsaturated polyester resins suitable for the formulation of the powder gel coat;(ECPE 8b1, ECPE 8b4, ECPE 8b1N, ECPE 8b2N, ECPE 7b3, ECPE 10b2, ECPE 10b2N, ECPE 10b1 I, ECPE 10b1 IPA) was accomplished and powder unsatured polyester resin 8B2N was selected. Based on the gel time and Tg values obtained during Unsaturated Polyester resin design and development step and on the powder gel coat storage stability considerations, the initial curing package selection for starting powder gel coat formulations laboratory shots were made up of Di-benzoyl Peroxide and Tolu-hydroquinone or Tert-Butyl-hydroquinone. At the end of this work package, 6 different formulations of the non-conductive powder gel coat with 3 different resin grades (8b1N, 8b2N and 10b2N), were successfully tested to fulfil ECOGEL CRONOS process requirements. The cross-linker included in all those formulations is determined but the optimum dosage for the initiator had to be settled in the 1,5% - 3% range. Results obtained with the powder gel conductive primer trials also shown several formulations fulfilling ECOGEL CRONOS process requirements as well as surface conductivity targets. The catalytic system employed in this case is pretty much reactive so new adjustments are necessary to improve this formulation. Finally, the resin grade selected for the topcoat and the conductive primer initial testing at the pilot plant mould was ECPE 8b2N. Powder spray parameters were also determined within this WP. *Powder gel coat Quality control plan:*

POWDER GEL COAT QUALITY CONTROL PLAN - Edition 1 February 2015

CHARACTERISTIC	TOLERANCE RANGE	TEST STANDARD
Gel Time 120ºC	30 - 60 seconds	ISO 8130 - 6
Max. Peak Temperature (ºC)	140ºC - 146ºC	
Particle Size over 10µ	> 95%	ISO 8130 - 13
Particle Size over 75µ	17% - 21%	ISO 8130 - 13
Particle Size over 120µ	< 2,5%	ISO 8130 - 13
Particle Size D_{50}	25 - 45µ	ISO 8130 - 13
Colour Difference (ΔE CMC)	< 0,6	BS 6923
Visual colour Difference	According to DAF colour master	

Powder particle size distribution was determined:

-Mean Particle Size 25 - 45µ
-Particle Size over 10µ: >95%
-Particle Size over 75µ: 17% - 21%
-Particle Size over 120µ: < 2,5%

CONCLUSIONS

At the end of this work package, different unsatured polyester resin were developed and one was selected to develop powder gel coat. Finally, powder gel coat non-conductive & conductive formulation was selected and some samples were ready to start with pilot plant applications as well as cured film testing stages for the final formulation adjustment in WP3. All formulations selected fulfill ECOGEL target regarding, Tg, storage stability, electrical conductivity and gel time to film formation.

WP3 STUDY OF POWDER GEL COAT CURING AND RESIN-GEL COAT INTERFACE							
Participant	**AIMPLAS**	SBS	CI	CLERIUM	INDUPOL	AXON	NETCOMP
	EXSTREAM	DUASA	ECOINNOVA	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES:	WORK PERFORMED:
Objectives: The first WP3 objective was related to the definition of the curing conditions of several powder gel coat developed and selected in WP2. The second one was focused on the assessment and improvement of the compatibility between different types of resins (unsatured polyester, vynilester, furan, epoxy…) and the powder gel coat developed by means of simulation programmes and tests at pilot plant level. All the test were completed in a pilot plant RTM scenario at AIMPLAS facilities so the results obtained were used for the industrial mould construction in WP4.	**Description of work** Task 3.1 RTM pilot plant mould design and construction. Task 3.2 Powder gel coat- resins interface modelling. Task 3.3 Powder gel coat curing parameters in a RTM production scenario at pilot plant level. Task 3.4 Modification of epoxy resins. Task 3.5 Modification of urethane-acrylate and vinylester resins. Task 3.6 Assessment of resins and powder gel coat curing parameters in a RTM production scenario at pilot plant level.
COMPLETION DEGREE (%)	The objective was 100% successful from the technical point of view.

RESULTS

Within this workpackage a simple plain prototype pilot plant mould (figure 5) was built with a heated system in order to assess powder gel coat curing parameters.

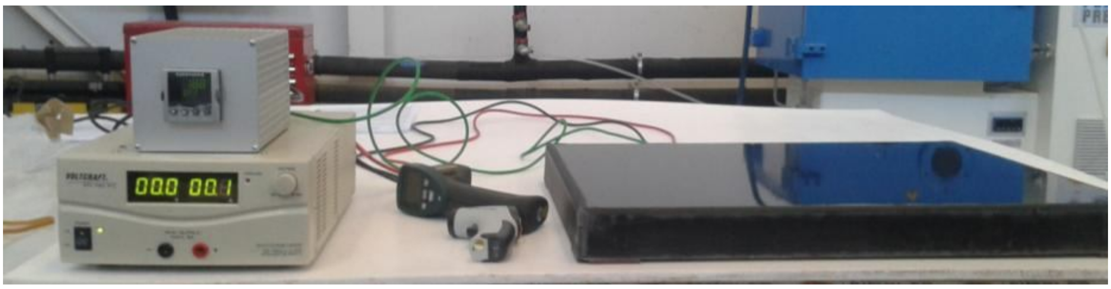


Figure 5. Pilot plant and temperature control system set up.

Digimat-FE software was employed to obtain electrical conductivity percolation threshold of different carbonaceous fillers for conductive powder gel coat formulation and to validate experimental results obtained in extrusion trials (**figure 6**). Additionally, Digimat-FE was used to predict mechanical properties of different laminates with respect to component properties and contents, which contribute to improve composite design phase.

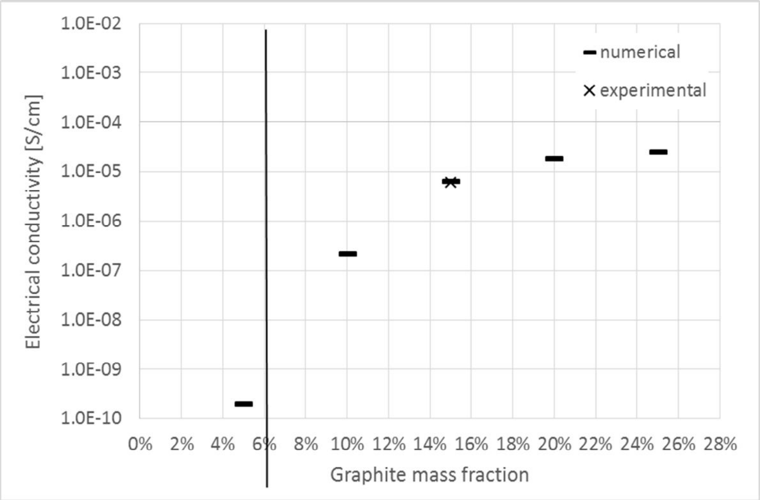


Figure 6. UP/EG updated numerical predictions

Regarding powder gel coat formulations, different laminates were obtained with the formulations developed with conductive & non-conductive powder gel coat formulations. Laminates obtained were tested to determine degree of cure by DSC, surface quality, QUV resistance, cross-cut test and Chemical resistance Additionally, electrical conductivity and tests on electrostatic final painting were completed only for conductive powder gel coat. The range of thickness is advised to be around 150 microns.

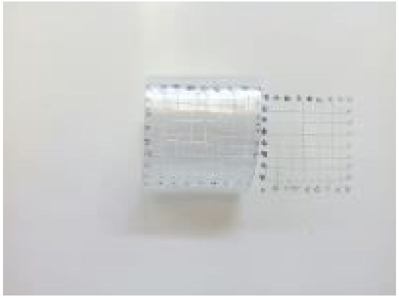
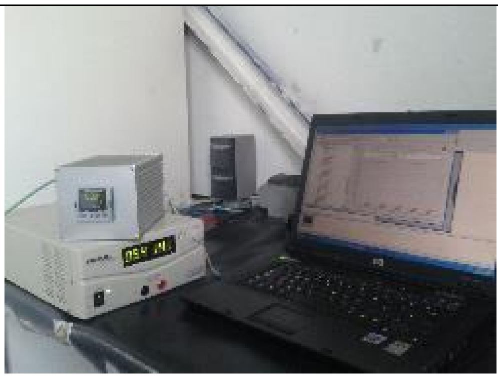


Figure 7 Cross-cut test in conductive (right) and non-conductive (left) laminates.

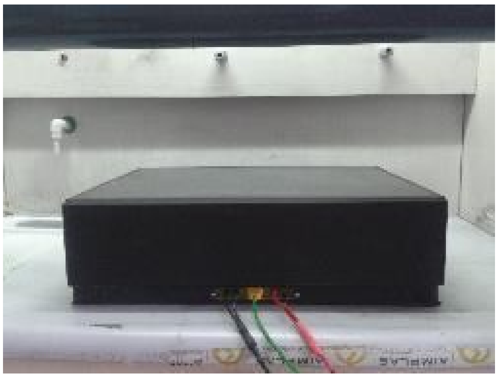
Finally, non-conductive powder gel coat formulation and conductive powder gel coat formulation were selected although minor tests/adjustments were necessary before starting scale-up in WP5.

Regarding process parameters is established that, although two release agent were tested, further tests are necessary when using electrically heated mould to determine the compatibility between release agent and mould materials. Mould surface temperature for powder gel coat application at lab. Level was determined. When applying non-conductive powder gel coat best results are obtained when the mould is previously heated. However, when conductive powder gel coat is applied best results are obtained when the mould surface is at room temperature. Oven curing of powder gel coat is possible. Nevertheless, it is important to highlight that the surface quality obtained is far better when using electrically heated moulds (FHBI pilot mould). The process completed to obtain laminates using the FHBI mould was detailed in figure 8.



a

b



c

d

Figure 8. Process to obtain laminates using FHBI mould.a) Mould temperature is programmed to 130ºC b) Once this temperature is reached, powder gel coat is applied, c) mould is closed for 1 minute, d) laminate is applied on the mould surface over the powder gel coat following hand-lay up method.

Regarding epoxy, vinylester and urethane acrylate resin modifications, it is concluded that adhesion of non-conductive powder gelcoat to the unmodified epoxy resin is at least as good as to the liquid gelcoat. Adhesion of non-conductive powder gelcoat to unmodified vinylester and unmodified urethane acrylate cured castings are weaker than the same for liquid gelcoat but the addition of coupling agents is improving adhesion, this is especially evident in urethane acrylate resin.

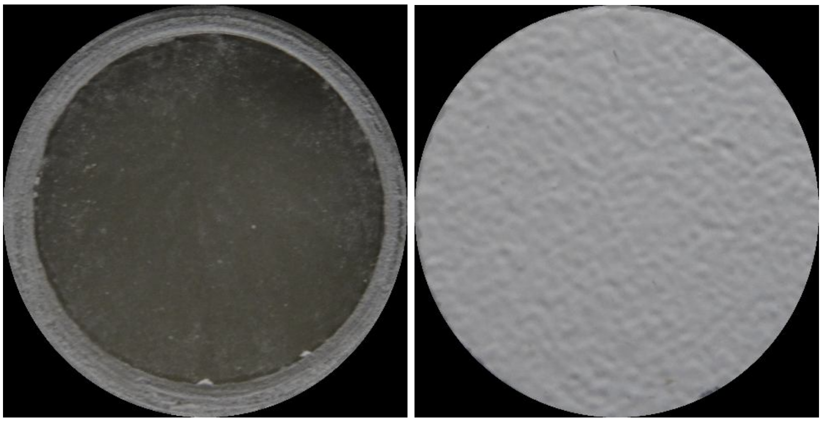


Figure 9. The non-separated dolly on urethane acrylate unmodified.

CONCLUSIONS

At the end of this work package, a non-conductive and a conductive powder gel coat formulation was selected to scale-up in WP5. Minor adjustments are needed before scale-up

Moreover, the development of injection resin formulations that enhance compatibility between powder gel coat and laminated part improving chemical interphase and thereby the quality of the finish composite was accomplished. Epoxy resins shows a good compatibility with powder gel coat and it is possible to improve adhesion of vinylester and urethane acrylate resins by means of the addition of coupling agents.

WP4 Electrically conductive hot mould for RTM process.							
Participant	AIMPLAS	SBS	CI	CLERIUM	INDUPOL	AXON/FAR	**NETCOMP**
	EXSTREAM	DUASA	ECOINNOVA	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES:	WORK PERFORMED:
Objectives: The main objective of work package 4 is the design and prototyping construction of efficient electrically conductive heated skins. At the end of this work package a prototype RTM mould will be obtained in order to assess its electrically conductive capacities to apply the powder gel coat and its heating capacity to reach polymerization temperature for powder gel coat film formation.	**Description of work** This work package is divided into eight tasks: Task 4.1 Modelling of "skin" mould resin electrical, thermal and thermo-mechanical properties. Task 4.2 Electrically conductive gel coat tooling development. Task 4.3 Selection of high Tg epoxy resins. Task 4.4 Electrically conductive heated skins development. Task 4.5 Design and construction of electrically heated prototype skins mould and temperature controller. Task 4.6 Insulation of tooling skins. Task 4.7 Initial test of capacity of heat of develop system. Task 4.8 Case studies' electrically heated skins development.
COMPLETION DEGREE (%)	The objective was 100% successful from the technical point of view.

RESULTS
Simulations were performed to test the mechanical deformation for the skin mould (figure 10 and figure 11). When study the deformation of skin mould under its own weight a very weak mechanical deformation of the skin resulted. However, when study the deformation due to the thermal loading during manufacturing, the results shown displacement at the end of the cooling process what is related to the fact that the coefficients of thermal expansion are different for each material used in the skin but also due to the skin layup. After performing different numerical simulations for different layup configurations to decrease this deformation, it were identified different layup that decrease these deformations if necessary.

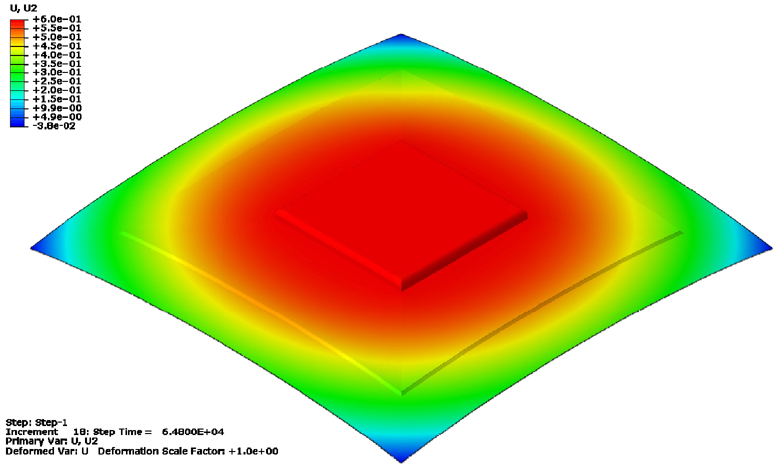


Figure 10: Deformation of the mould for at the end of the manufacturing process of the mould (20°C).

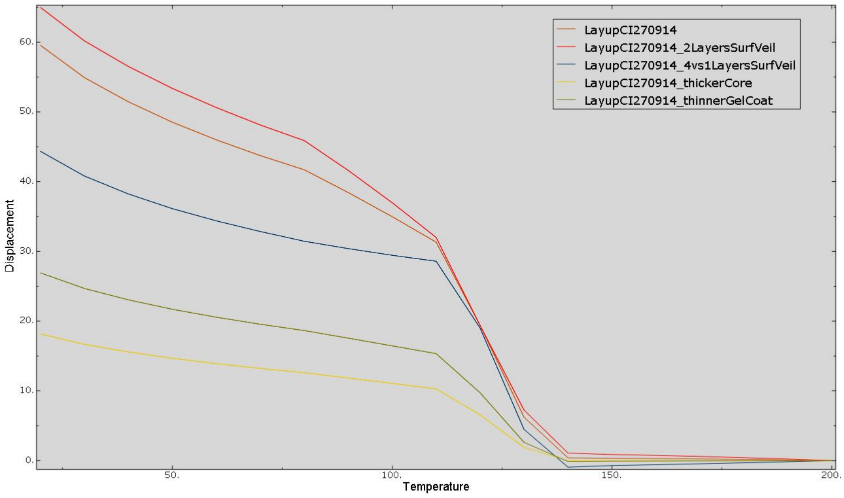


Figure 11: Maximum deflection evolution for different skin layup.

Regarding, **electrically conductive gel coat tooling development**, it was agreed by the consortium that a commercially available electrostatically conductive gelcoat should be employed for skin manufacturing. This is due to the fact that the commercial gelcoat contains around 15% wt carbonaceous materials. Furthermore, the addition of more CNT or conductive additives produces no improvement in electrical conductivity. As the skins are manufactured with a combination of a gelcoat and a compatible epoxy resin a compatible high Tg epoxy resin was selected with a glass transition temperature located at 220°C [DSC].

With regards to, **electrically conductive heated skins development, design and construction**, a new manufacturing concept was developed to produce the sandwich backing of the structure in a cost efficient and productive way. Flat panel trials shown that the carbon heating technology works, without causing damage or distortion to the laminate with the specified layup (figure 12).

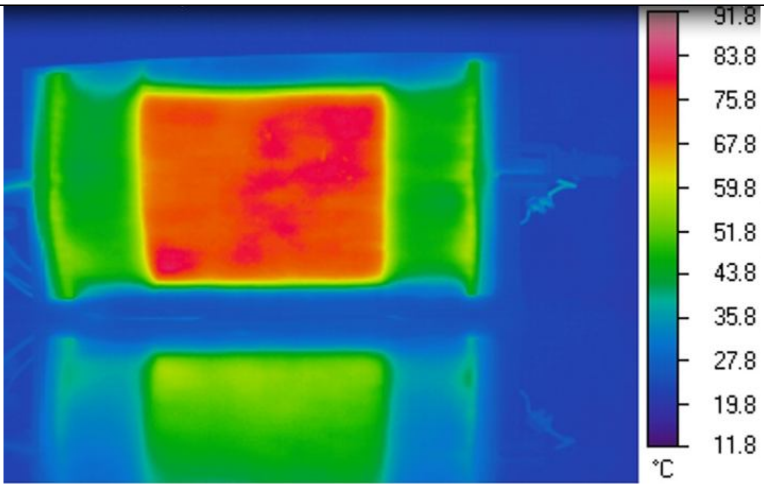


Figure 12. Example image showing emissive heat from flat panel.

According to this, prototype mould was CAD designed and was built.

Figure 13. WP4 electrically heated mould.

Initial test of capacity of heat of developed system shown that although the skins will ultimately reach the requested temperature of 130°C (when insulated), the time to reach the temperature is currently too slow for commercial application and the temperature distribution across the skin was poor. In order for the powder coating process to be fully functional and robust, the variables within this process which need to be systematically addressed before a suitable coating can be achieved was listed and were fed into WP6.

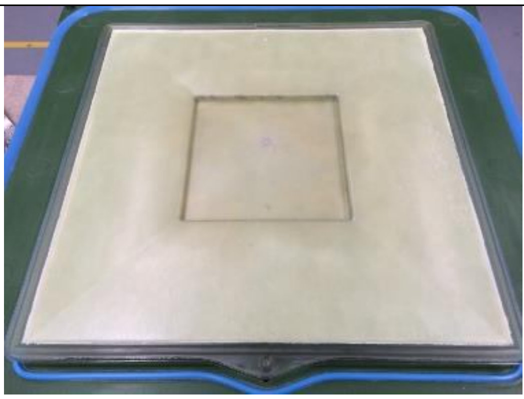


Figure 14. The underside of the moulded part showing the successful wet-out of the preform.

Finally, different options were examined to improve the overall performance of the skins to be applied in demonstrators mould construction (WP6).

CONCLUSIONS

Results showed that although the skins will ultimately reach the requested temperature of 130°C, the time to reach the temperature should be decreased and temperature distribution across the skin improved to push commercial application of this technology. According to this, new options to improve the overall performance of the skins were discussed and implemented in demonstrators mould construction (WP6).

WP5 Development of new fibre preform and hybrid adhesives.							
Participant	AIMPLAS	SBS	CI	**CLERIUM**	INDUPOL	AXON/FAR	NETCOMP
	EXSTREAM	DUASA	ECOINNOVA	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES:	WORK PERFORMED:
Objectives: The main objective of this work package is to optimize material-interface for the binder-resin, and metal/polymer-composite improving adhesion properties to parts coated with the developed power gel-coat. New technologies for joining composites to metal (inserts or metal parts used in the automotive sectors) or composites to other polymeric materials (preform-injection resin or composite-composite) will be proposed.	**Description of work** Task 5.1 Binder selection. Task 5.2 Preform specifications, preform mould, unit setup and scale-up. Task 5.3 Improving chemical union between polymer/composites and metal/composites. Task 5.4. Characterization of the adhesion properties of the new two component adhesive in different substrates.
COMPLETION DEGREE (%)	The objective was 90% successful from the technical point of view. Regarding conductive powder gel coat formulation, it was found that film formation is not good enough to obtain a suitable electrostating /e-bath painting. Moreover, some minor benzene emissions appears in conductive powder gel coat formulation. Then, further adjustments in conductive powder gel coat are necessary to reach commercial applications.

RESULTS
Simulation model by reverse engineering for the Ecogel Cronos laminates using preforms and the selected resins was completed. After this simulation, it is concluded that, **binder** content is very low in a preform and as expected, the influence on the mechanical properties is negligible. Therefore, the binder is chosen based on ease of processing and environmental advantages. According to this, the binder selected is the multifilament thermoplastic yarn. Permeability tests (figure 15) were completed to study the resin flow behaviour in a preform and select the one with higher permeability.

Figure 15. Permeability tests.

Preforms for WP4 was designed and built. The preform mould for WP4 was built using a splash. The robot was programmed and the unit was setup for preform production for the WP4 preforms. A number of preforms were produced and sent to be tested with good results in WP4. A finished part was sent back to Clerium for inspection.

The design of the **WP6 preform moulds** has been done for INDUPOL demosntrator part. Again, this preform mould was built using a splash (figure 16). Adittionally, models were used to manufacture composite supports for the transport of preforms. The models are also built as a security measure. If the preform moulds get damaged because of the temperature, models are available to build new preform moulds. Finally some prefrms were manufactured and sent to INDUPOL for parts manufacturing (WP6)

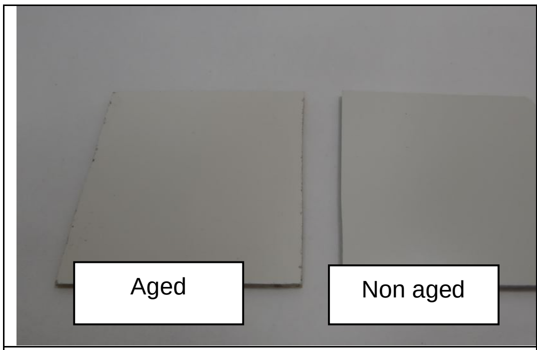
Figure 16. INDUPOL preform mould

As a results of task 4.8, in WP4, some efforts have been devoted to obtain a **Class A surface on the heated mould skins**. Several tests were performed with different high temperature epoxy gelcoats (figure 17). At first, several thin laminates were built and later more test were done with the real thickness and configuration of the heated skins. The samples were post cured very carefully and good results are obtained applying the results in mould construction (WP6).

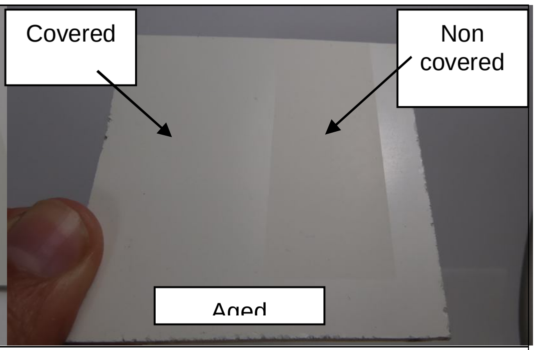
Figure 17. Different laminates obtained with Class A surface – tests for mould construction.

<u>Scale-up process of powder gel coat formulations.</u>

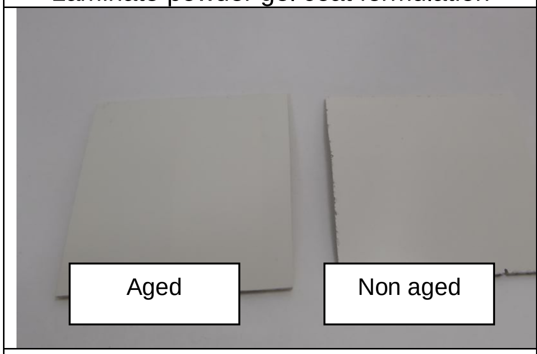
Additional tests such as chemical resistance tests, artificial weathering tests (Figure 18) and electrostatic painting were accomplished with good results before starting scale-up process of both formulations (non-conductive and conductive). Regarding electrostatic painting, it is important to highlight that a good film formation when conductive powder gel coat is applied is the only condition that guarantee optimum results in the electrostatic painting line.



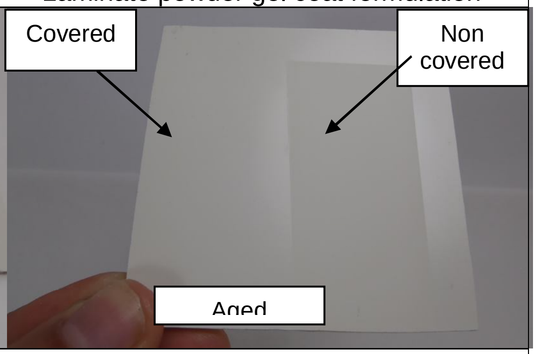
Laminate powder gel coat formulation



Laminate powder gel coat formulation



Laminate de Liquid gel coat INDUPOL -GEL COAT



Laminate de Liquid gel coat INDUPOL -GEL COAT

Figure 18. Images of different laminates after artificial weathering according to UNE-EN-ISO 4892-2.

Scale-up process of both formulations (non-conductive and conductive) were accomplished at SBS facilities. Figure 19 and figure 20 show extrusion parameters and some pictures of scale-up process.

Figure 19. Pictures from scale-up process of conductive powder gel coat final formulation.

Figure 20. Images of extrusion parameters of non-conductive powder gel coat,

A new concept of two-component (2K) formulation by combining two of the most powerful adhesives: epoxies and alkoxysilane functionalized polyurethanes was accomplished. Different **hybrid adhesives** were formulated in order to achieve the specifications required by the OEMs. the adhesion properties of the newly developed two component hybrid adhesive were characterized using different types of "typically difficult" plastic (composites, polymers, etc.) and metallic (aluminum (metallic and anodized), steel, carbon steel, etc.) substrates. Based on the different tests accomplished, the final formulation was selected.

CONCLUSIONS
WP4 and WP6 glass preforms were successfully manufactured and sent to end users for trials at industrial level, concluding that the implementation of a fibre preforming unit can effectively contribute to reduce fibre waste. Materials to obtain **Class A surface in resin moulds** were investigated with good results, using these materials in WP6 mould construction. Additional tests were completed with conductive and non-conductive formulations. Finally, **scale-up process of conductive and non-conductive powder gel coat** was completed and samples were sent to end users for final trails. At the end of this work package, a non-conductive and a conductive powder gel coat formulation that reduce film time from hours to a few minutes and eliminate the styrene emissions in a production plant of composite parts was completed. However, in conductive powder gel coat, although overall VOCs emissions are reduced and styrene emissions are eliminated, some benzene emissions appears. Moreover film formation should be improved. Additionally, new **high performance 2K hybrid adhesive** based on chemical join polyurethane and epoxy groups that permit a suitable integration of develop coated composites parts with metallic parts or other composite parts was accomplished.

WP6 CASE STUDIES PRODUCTION AND VALIDATION							
Participant	AIMPLAS	SBS	CI	CLERIUM	**INDUPOL**	AXON/FAR	NETCOMP
	EXSTREAM	DUASA	ECOINNOVA	KETEK	CIDETEC	MEGARA	FHBI

OBJECTIVES	WORK PERFORMED:
Objectives: The main goals on this WP are: • to optimize Resin transfer Moulding (RTM) high productivity line for long term use (D6.20) • to manufacture demonstrators selected in WP1, which will contribute to show the advantages of the new technology developed and to validate the parts obtained (D6.19, D6.21, M8).	**Description of work** The demonstrators moulds were designed, built and installed at INDUPOL and at AXON premises and properly trained workshop personnel was in charge of the RTM line optimization phase. Consortium partners and relevant third parties were invited to visit the facility. The demonstrators' validation was accomplished by testing the materials according to Indupol and Axon specification defined in WP1. This work package is divided into the following tasks: Task 6.1 Process Simulation and mould design. Task 6.2Manufacturing of models and moulds Task 6.3 Process automatization study and short run of parts to ensure speed of process and quality Task 6.4 Long term optimisation stage Task 6.5 Final part assembly Task 6.6 Automotive and agriculture equipment parts validation
COMPLETION DEGREE (%)	The objective was 90% successful from the technical point of view. Regarding electrically heated technology, it was successfully demonstrated in plain parts (AXON mould) but further adjustments are needed to obtain homogeneous heating when this technology is applied in more complicated designs.

RESULTS
Simulation of different options for resin injection strategy and vacuum ports in the door skin demonstrator mould were accomplished. The results obtained were assessed to determine injection flow, filling time and maximum pressure in order to contribute to define manufacturing process and to avoid issues such as incomplete mould filling or injection resin losses.

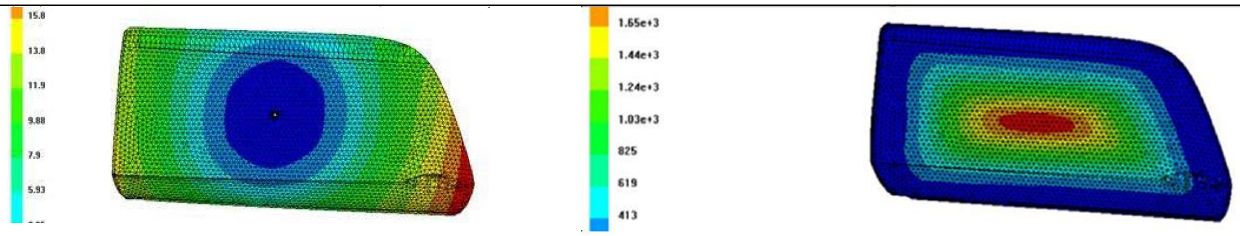


Figure 21. Simulations on; left) injection strategy 1 and right) injection strategy 2

Thermo-mechanical simulations of the AXON mould were performed using the MSC.Software Marc finite element modeller, coupled with e-Xstream Digimat material modeller. As a result of AXON MOULD simulation, it is concluded that the thermo-mechanical strains may lead to significant deflection when using a non-symmetric layup. However, using a very thick honeycomb-based core decreases this deflection to a nearly negligible value.

Simulation 2-a	
Layup	CI021215 (19mm honeycomb-based)
Boundary conditions	Stress-free, homogeneous cool-down from 200°C to 20°C
RESULTS	
Maximum deflection	3.5mm
Deflection pattern	Picture below: deflection pattern at 20°C

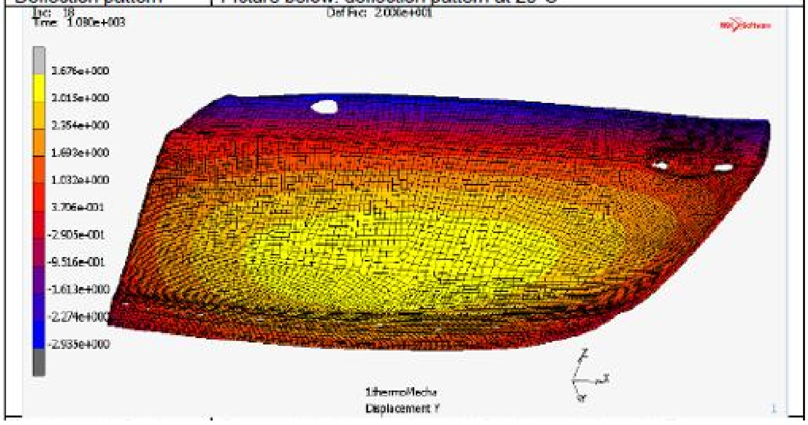


Figure 22. Simulation 2 a results.

Regarding mould construction, the tooling method used at CI is cost effective and simple to produce and to use. This therefore makes it simple to build into a Production Process. It is important to keep the Production Process as fluid as possible. Both moulds (AXON & INDUPOL mould) are built based on this and were ready for parts manufacturing on time.

INDUPOL DEMONSTRATOR

During first trials, pre-release problems were faced and finally modification to the non-conductive powder gelcoat were arranged to reduce shrinkage an adapted non-conductive formulation was obtained. After different trials, a LELY cover part of acceptable quality was obtained although there are some areas with surface defects. Theses defects are due the fact that the mould heating in these areas is higher what bring about pre-release problems (figure 23).

Figure 23. LELY cover part with non-conductive powder gel coat.

When spraying powder gel coat, applying immediately the full thickness has proven to be the best approach taking curing, bonding and coat thickness into account. When the powder is cured and the product released from the mould, the surface is tough, hard and has a smooth surface.

The preforms and injection system work well and are a proven concept. They provide an advantage in speed and process repeatability.

It is clear that ECOGEL RTM process can contribute to reduce cycle time mainly for the reduction in curing powder gel coat time and in fiber placement when preforms are used. Moreover, the temperature needed to cure the powder gel coat can be used to introduce new resins that can decrease the cycle time. Then, it is expected that making certain changes in some process parameters, the final cycle time per part will be decreased up to 58%.

AXON DEMONSTRATOR

With the help of project partners, Axon have sourced and commissioned all equipment necessary and solved numerous production issues to develop to a repeatable manufacturing process. Finally, parts with good quality were obtained (figure 24).

Figure 24. *Door skin Black (conductive) and door skin White (non-conductive))*

From Axon's perspective the conductive powder gelcoat still requires development in order to improve film formation.

The adapted non-conductive formulation was employed in August and good quality parts were obtained. In this case**, technology is successfully demonstrated** (figure 25).

Figure 25. Demoulded door skin showing the non-conductive gel coat

It would currently take Axon Automotive around 270 minutes to produce a door skin component with the current equipment and process. Based on process parameters estimations, it should be possible to produce a part in approximately 36 minutes with a single tool. By using multiple heated skins the TAKT time for automotive sector could be met assuming the skins can be modified to take a higher cure temperature.

Concerning **final part assembly** was completed by means of_e-coating process at AXON demonstrator. It is proved that e-coating process is possible but getting a good conductive powder gel coat layer on the composite is necessary to improve final part surface quality. In both demonstrators, hybrid adhesive is available for testing.

Regarding **automotive and agriculture part parts validation**, it is concluded that properties of the laminates manufactured using Ecogel materials and technology are at least as good as those produced using standard materials and technologies.

CONCLUSIONS

Non-conductive powder technology was successfully demonstrated.

Regarding **electrically heated technology**, further developments are needed for complex parts. It is concluded that to investigate the potential of thin, interchangeable, heated tooling skins can bring many benefits within production processes so this opens the possibility of new developments.

Conductive powder gel coat technology has a wider application in different sectors apart from automotive sector e.g. electrical conductive deposits to avoid electrical discharges. However, as explained in WP5 conclusions, further developments to enhance film formation and adapt electrical conductivity values to the final application providing new opportunities in the composites sector.

WP7 ECONOMIC, ENVIRONMENTAL AND HEALTH EVALUATION							
Participant	AIMPLAS	SBS	CI	CLERIUM	INDUPOL	AXON	NETCOMP
	EXSTREAM	DUASA	ECOINNOVA	**KETEK**	CIDETEC	MEGARA	FHBI

OBJECTIVES	WORK PERFORMED
The target of this WP was to fulfil a viability study on the economics and environmental (LCA) aspects of the materials and processes developed in **ECOGEL CRONOS** project taking into account raw materials, electrically conductive hot tooling technology, preforming features and operation savings of the whole production technology. This study was mainly concentrate in the **ECOGEL CRONOS** case studies demonstrators selected in WP1.	**Description of work** Task 7.1 Economic evaluation. Task 7.2 Environmental evaluation Task 7.3 Health, Regulatory and Safety issues

COMPLETION DEGREE (%)	
	The objective was 90% successful from the technical point of view. VOCs emissions results in conductive powder gel coat determine minor benzene emissions, then further modifications in conductive formulations are needed.

RESULTS

The main emphasis in **economic evaluation** was to estimate the price of the chosen demonstrators and then make an estimation of savings the new Ecogel-Cronos proposed process. Direct costs related to costs of materials, tooling, labour and process energy were estimated for 3 various light RTM production routes using Ecogel-Cronos materials. Results were compared to light RTM process using traditional materials. The main outcomes of the viability evaluation are as follows:

- Although powder gel coat material cost is higher than liquid gel coat, powder gelcoat consumption for application process is remarkably less and therefore material costs for coating 1 m2 are 24,6% lower than coating with liquid gelcoat.
- When production volume is as high as 20 000 and more for automation of the process light RTM with heatable skins is an ideal option.
- labour costs per part when using Ecogel-Cronos materials will be reduced by approximately 62% when compared to conventional materials and processes.

- Changing process from conventional to Ecogel (light RTM) 58% savings related to waste generation and disposal can be reached due to reduce amount of plastic material (rolls, floor covers, etc) and glass fibre waste.
- Elimination of styrene from the process would allow saving at least 0,03- 0,13€/part (60-86,7%)

depending on the country parts are manufactured.

Overall direct costs for production of one part

- Ligth RTM process using Ecogel materials and removable skins has clear advantage for Axon, at least 15% costs benefit is reached. Utilization of removable skins allows for Axon to automise the process and reach the TAKT time they require (figure 27).
- The same statement is valid for Indupol when the volume of 1000 is reached (figure 26).

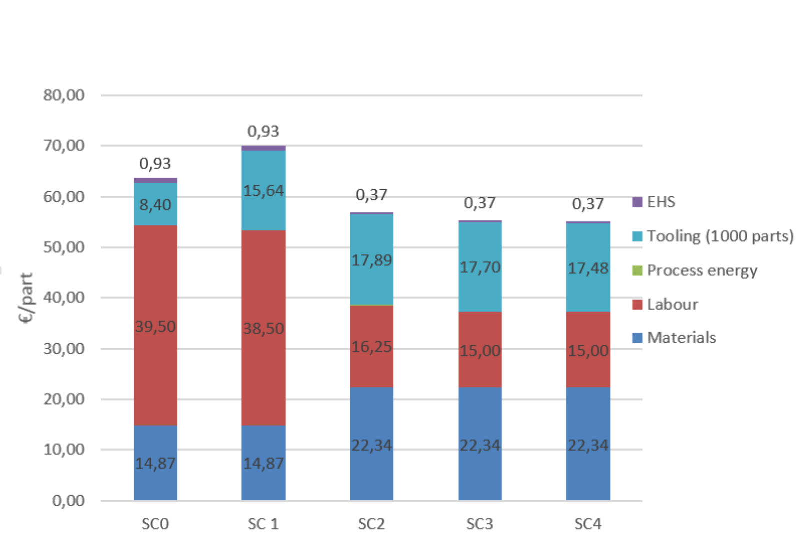


Figure 26. Costs of production of one part by Indupol, 1000 parts

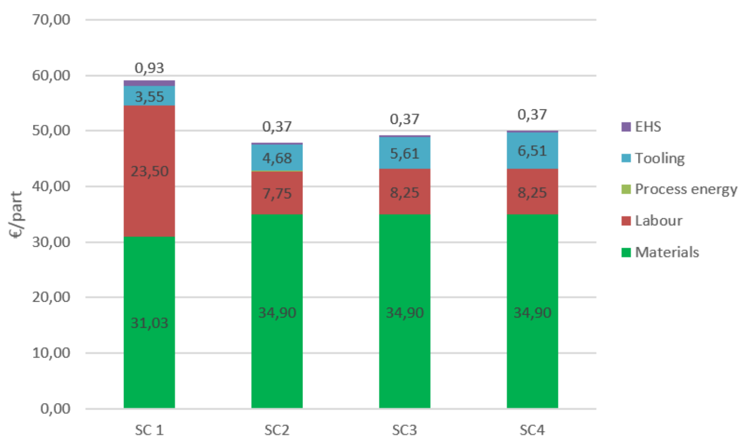


Figure 27. Costs of production of one part by Axon, production rate 20000 parts.

The main approach in performing **LCA in Ecogel project** was to compare LCA of conventional materials and technologies used for production of **mover cover** (INDUPOL demonstrator) and **car door skin** (AXON demonstrator) with solutions Ecogel project is bringing.

In case of **mover cover LCA** only LCA of material extraction and production stages were compared, as there is no different in weight of the composite, regardless which technology was evaluated, conventional or Ecogel.

The main outcomes of mover cover LCA are as follows:

• It was established that the powder gelcoat has lower impact on most of the 14 indicators; global warming potential as CO_2 eqv is 45% lower than that of liquid gelcoat. The main reason for that is use of significant quantities of volatile solvent styrene in liquid gelcoat production and further high emissions of this solvent during gelcoating process. Additionally powder gelcoat is reusable and the estimated waste is very minimum.

• Introduction of removable heatable skins into Ecogel technology increases however in a very low extent global warming potential and non-renewable energy.

• Reduced amount of energy needed for production of raw materials and energy for ventilation to comply with styrene exposure limits in the workshop is facilitating reduced amount of non-renewable energy in Ecogel process. Energy is saved also due to less compressed air needed for applying powder gelcoat.

• When the impact of whole production phase including raw materials, skins, production and waste is considered, there is approximately 27% lower impact on global warming for part produced by Ecogel process.

The main goal of **door skin LCA** is to compare cradle to factory gate the energy and environmental impacts of car door-skin produced utilizing Ecogel materials and production technology and conventional steel door-skin. Because there is significant difference in weight of Ecogel composite part and part produced in steel also use phase of the vehicle's LCA is performed. For this the prediction is made that car body would have potential to reduce its weight by replacing steel body part by composite and have 185 kg or 39% weight reduction. The main outcomes of mover cover LCA are as follows:

• Global warming potential for production stage of the composite door comparing to the steel door-skin is 43% lower and non-energy consumption is 17% lower for door-skin produced in composite than in steel. Because of significant mass change of the door-skin when steel is replaced by composite (53%), there is significant reduction of global warming potential and non-renewable energy in use phase (57% both) (figure 28). This is due to significantly reduced consumption of fuel.

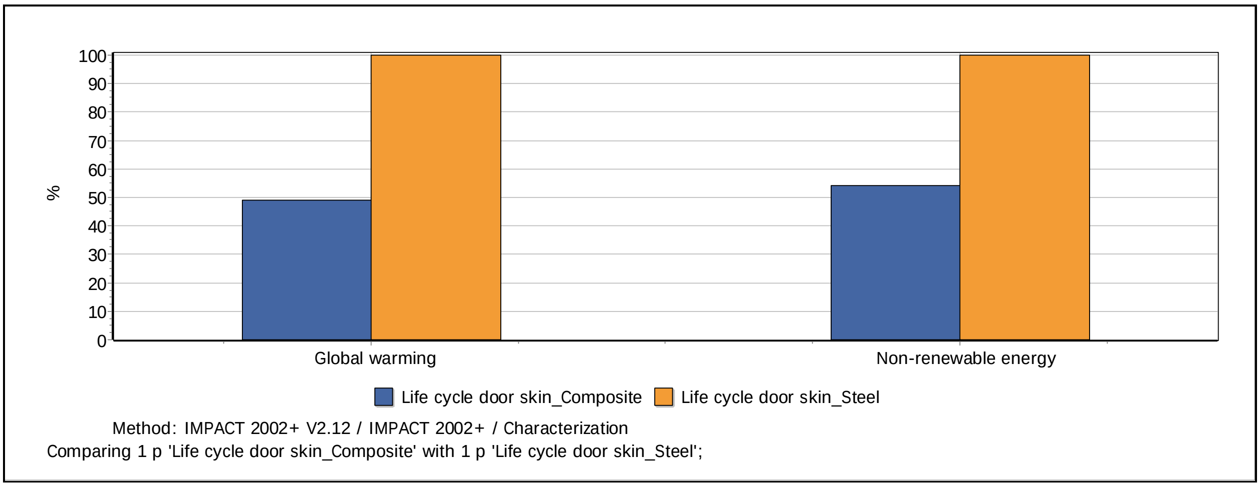


Figure 28: Comparison between steel and composite door-skin for impact categories global warming and non-renewable energy

- Based on LCA for door-skin global warming potential savings for use phase of car when only steel body is replaced by composite body could be up to 7,4 t CO2 eqv. This value though is theoretical and calculated basic on mass-induced fuel consumption. According to literature sources, this value is too high. According to source 0.35 liters is saved per 100 km for 100 kg weight reduction for gasoline vehicles. It is equivalent to 0,8 t CO2 eqv. According to those assumption there would be 2,8 t CO2 eqv savings during the use phase of the composite body car.

Regarding **Health, Regulatory and Safety issues,** different areas were explored. The work completed was carried out in two stages.

The first was to collect and collate all the information the project partners can supply relating to current best-practice in the workplace. This includes all standards, legislation and best-practice guidance that partners currently comply with in the work carried out towards the objectives of Ecogel Cronos. It also includes data comparing the technologies developed within the project with current, commercial technologies. Regarding standardization, in early 2016, an assessment of the standardisation options and a summary of the expected outcomes of the project were sent to the secretary of AEN/CTN 48.

The second part shows how the technologies and practices developed within the project offer benefits, in terms of VOC emissions, over the current technologies. It was found that using non-conductive powder gel-coat in place of the conventional, liquid gel-coat could reduce the emission of VOCs by a factor of 30. Using the conductive powder gel-coat could reduce the emission of VOCs by a factor of 10. Of the volatile substances accounted for, in only one instance (benzene, in the conductive powder gel-coat) does the measured amount exceed the time-weighted-average (over a period of 8 hours) limit. Benzene emissions in conductive powder gel coat are thought to be caused by the catalytic system employed during powder conductive gel coat formulation and by the higher temperatures needed to film formation. As a conclusions, conductive powder gel coat formulation should be adapted to remove benzene emissions and to improve film formation.

CONCLUSIONS

Economic study was successfully completed. It is demonstrated that ECOGEL production process is competitive compared with liquid gel coat.

LCA study proves that Ecogel materials (powder gelcoat) and technology are superior to other light RTM technologies in composites production as well as to steel components production.

Regarding health, Regulatory and Safety issues, a complete revision, including VOCs emissions, was accomplished and a recommendations guide for application was completed at the end of the project.

1.4. Potential impact and main dissemination activities and exploitation of results

Dissemination Activities

It is essential to highlight that a considerable number of dissemination activities have been completed during the development of the ECOGEL project, i.e. **more than 30 communications made** (considering the different press releases; publications on partners´ websites or any other website page; articles in magazines, newspapers, etc; technical articles and posters, scientific publications, different project flyers adapted to the partners´ business interests; project presentations to clients or any other audience, project videos); and **almost 20 dissemination activities** in different events (fairs, conferences, workshops, info-days, exhibitions). All the details are given in the Dissemination Activity tables PDF submitted as deliverable D8.34. Moreover, there are 1 final press release published in September 2016 on the project final results, JEC Magazine October/November 2016 and 1 FoF event (***Concluding Event: Factories of the Future – Making Innovation Happen***, on 01/12/2016) performed/to be performed before the end of 2016.
The project information has been disseminated via three channels:

a) By partners, within their organizations and with their clients/contacts (e.g. companies websites, newsletters, meetings, training courses, etc.)
b) By partners, during external events (e.g. fairs, conferences, exhibitions, workshops, etc.)
c) By partners, using media across Europe (e.g. press release, Internet, specialized/sectorial magazines, etc.)

The use of various channels and methods (written, face-to-face & online) assured an optimal contribution of coverage, visibility and most important- setting up the scene for better market acceptance in the near future.

The activities in the Dissemination Plan covers different audiences and channels depending on the type of information to be disseminated, in order to assure the success of the project from a strategic, environmental, technologic and economic direction based on ECOGEL approach.

Dissemination tools and activities were divided in two main groups:

a) *Industrial level*: For the industrial partners, the principal objectives are to obtain results that will increase their competitiveness and market opportunities and to show these results to any potential client, in order to have a wider commercial activity and increase the company benefits. Activities such as participation in fairs, seminars, exhibitions, press releases on the new potential products…are aiming these results.
b) *Non-commercial level:* The RTD participants (AIMPLAS, CIDETEC, KETEK) and FHBI University are more focussed in non-commercial promotion and scientific aspects of the work. Only non-confidential project results are susceptible of publication or dissemination in journals, web-sites, congresses, workshops, fairs and seminars.

The consortium is determined to continue the dissemination actions for the ECOGEL project after the end of the project, focused on both the commercial and scientific audience, as an essential pillar of their interest in continuing the project work (each partner in their specific business field), to move on in a possible future exploitation of the project knowledge (as detailed in the summary table further below).

Different Dissemination tools (marketing material) were prepared, such as:

-Maintenance of the Online portal – Website: **http://www.ecogelcronos.eu**

-ECOGEL Logo

-Brochures, flyers, postcards, posters

-Newsletter

-General presentation of the project

-Press releases

-Videoclips of the project results (the 2nd one, updated version and results, is available on the project website).

-Demonstrators for the project (more simple samples and the final demo parts)

All these resources are available at the Public part of the website and were used and displayed in fairs and meetings.

Potential Impact and Exploitation

ECOGEL-CRONOS project has contributed to the development of an innovative and high productivity Resin transfer Moulding (RTM) process by means of the two formulations of fast curing “zero VOCs emissions” powder gel coats (conductive and non-conductive), and the electrically conductive hot skin mould technologies based on laminates made of carbon-fiber- plastics (CFP laminates).

Two products, representatives of the advantages of this new production line for automotive and transport sector (agricultural equipment and good transport), have been developed within the project as demonstrators: a fully finished agricultural equipment part and a composite automotive part ready for e-coating bath painting treatment **successfully demonstrating powder gel coat technology,** for non-conductive formulation. Minor adjustments are needed for the conductive powder gel coat formulation**. Electrically heat technology was successfully demonstrated for simple parts**, being necessary further adjustments for complex ones.

In general terms, as quantitatively demonstrated in the previous section, after finishing ECOGEL, there are enough evidences that further work on the results obtained within the project, may **lead partners to commercial products or services** (at different levels within their specific business, depending on the partners´ profiles). It is a fact that there has been an advancement beyond the state-of-the-art, and it is partners´ objective to make use of it. The new knowledge acquired in the project can be transferred from project partners to their clients, so that some ECOGEL improvements are implemented in their current industrial processes and products, taking as a starting point the ECOGEL´s work.

Furthermore, it is of high relevance the impact that ECOGEL CRONOS project has provided to the European Commission different from the usual business impact from which the partners can benefit from. Specifically, ECOGEL CRONOS contributed to increase EU general industry knowledgement on:

a) **Standardization issues**.

   Before its involvement in Ecogel Cronos, AIMPLAS had not been involved in a formal standardisation procedure in an EU project. However, AIMPLAS is represented on national (Spanish) and EU standardisation committees and related official bodies. For example, AIMPLAS is member of CTN53: Plastics and Rubber Materials.

AIMPLAS devised, through internal discussions, a twin-track approach to the issue of standardisation of powder gel-coat, addressing requests to both the appropriate national committee (Paints and Varnishes, AEN/CTN 48) and the corresponding CEN (European) committee (CEN/TC 139). To make this approach as effective as possible, AIMPLAS coordinated research, within the project consortium, to collect all relevant information (standards, guidelines, etc.) relating to liquid gel-coats. In July 2015, in collaboration with the Spanish National Manufacturers Association of Paintings and Printing Inks (ASEFAPI), AIMPLAS determined the most efficient method of approaching standardisation within Ecogel Cronos.

This groundwork allowed AIMPLAS to be clearer in its requests to AEN/CTN 48, and to ascertain the correct contacts within the national standardisation body, AENOR. Through this, it was established that further development at a national level, rather than trying to repeat the discussions in other partners' home countries, would be necessary to smooth the progress of the approach.

In early 2016, an assessment of the standardisation options and a summary of the expected outcomes of the project were sent to the secretary of AEN/CTN 48.

As final result of this action, a **Standardization Request Report was generated with all the conclusions and work performed, and also sent to the Project Officer and PTA.**

b) Patent filling

After holding the 2nd Exploitation Strategic Seminar (ESS), partners involved in the development of one of the two powder gel coat formulations (conductive one), realized that if some simple samples were showed in Fair JEC WORLD 2016 (the major exhibition place for composites in EU), there was a big risk to have afterwards the chance to apply for append, as this fact could probably breach the innovation. Therefore, in just one month, and with all the technical work that was been developed so far, AIMPLAS contacted to a IPR patent lawyer, and they successfully filled in the following **PATENT nº 201630266, 'Formulation of the powder gel coat coating with electrical conductivity properties' applied on 08/03/2016.**

Another remarkable aspect of the Project Impact, is to have known what mainly partners obtained from the project and what they expect in the future, thanks to ECOGEL CRONOS participation. Therefore, based on the table included in PUDF-D8.34, section 3.2.1. Potential Key Exploitable Results, and as complementary and public information, please find the summary below.

Moreover, it is worthy highlighting that their contribution to the project as a whole consortium has also strengthened their potential business links for the future.

PARTNER	What did you obtain from the project?	What do you expect in the future?
1.AIMPLAS	-Increase knowledge about fast curing RTM process using power gel-coat and heated mould and skin. -Patent owner on nº 201630266, 'Formulation of the powder gel coat coating with electrical conductivity properties' -Memorandum of Understanding for the establishment of a business strategy and commercialization on the Formulation of the powder gel coat coating with electrical conductivity properties'. -Standardization report on the powder gel coat necessities in the European industry	-To apply the knowledge acquired about fast curing RTM process using electrically power gel-coat in other potential markets/projects, by means of looking for possible patent applications. - Do business thanks to Technology transfer, educational training & consultancy services. -Further development of the conductive powder technology to reach the market.
2.SBS	-Adapted extrusion equipment to produce at industrial level the new powder gel coat, and the related knowledge for producing it, being ready to be commercialized.	-To be part of the commercialization (business chain) of the powder gel coat, both as manufacturer and distributor, to widen their company´s portfolio.
3.CI	-Knowledgement on the new technology to produce skins and heated moulds for new RTM process for CI (the production of this tooling was an enjoyable challenge for them).	- There have been lessons learned through the production which could be investigated further. -Other materials might be better for the production of the tooling and should be considered during any further development work. CI is still very keen to investigate the potential of thin, interchangeable, heated tooling skins. There are too many benefits within production processes to ignore it.
4.CLERIUM	-New binder technology for fibre preform production in fast curing RTM process, improvements and further automation of the preforming process. -Increase knowledge of mechanical properties of parts made with preforms, improved preforms with excellent cosmetic finish.	- Expand into new markets. - Agreement with partners to sell powder gel coats to their customers, as distributor.
5.INDUPOL	-Knowledgement, at demonstrator level, on new more environmentally friendly, lightweight and cost effective production of composite parts applied to their products. -The preforms and injection system work well and are a proven concept. They provide an advantage in speed and process repeatability. -The Demonstrator is available for showing the results to their clients.	- There have been lessons learned through the production which could be investigated further, to provide extra heating for this cycle and could reduce this time significantly.

6.AXON/FAR-UK	-Knowledgement, at demonstrator level, on new more environmentally friendly, lightweight and cost effective production of composite parts applied to their products. -The Demonstrator is available for showing the results to their clients.	From Axon's perspective the conductive powder gelcoat still requires development. The conductive formulation does not melt together to form a skin. That is why AXON is interested in going on with further research with this tyep of powder gel coat. Despite the setbacks, a good quality part could be manufactured with the non-conductive coating, successfully demonstrating the technology. AXON would like to further work on in the case of a large-scale manufacturer producing thousands, or tens of thousands, of parts per year, where the opportunity to dramatically decrease the concentration of VOCs in the working environment becomes an attractive prospect, so long as the appropriate safeguards (good working practice and process controls) are in place.
7.EXSTREAM	-Simulation software for design materials to achieve the most suitable properties in an advanced RTM process. - Improved RTM knowledge based on the customers and market requirements, -Verification and validation of numerical simulations based on Digimat (e-xstream software product) platform wrt experimental data, - Improvement of methodology used in Digimat for RTM process, -Development of material data: development of digimat material model wrt to experimental data	-Extend client base -Agreement with materials developers to use data
8.NETCOMP	-Knowledgement on the new technology to produce skins and heated moulds for new RTM process (the production of this tooling has been an enjoyable challenge for them).	-Technology Transfer of the new RTM process to other industrial sectors (aeronautics, green energy, building, etc..). -Provide training & consultancy services.
9.FHBI	- Increase knowledgement on production heated skins for RTM process, based on a previous patent, Fibertemp.	-Technology transfer of new process in education and industry
10.ECOINNOVA	- Full control on the polymerisation kinetics of the powder gel coat, Consistency in the production of good finishing parts	- Exploit non-conductive powder gel coat formulation, through partners´ agreements. -Be part of the commercialization (business chain) of the powder gel coat, both as manufacturer and distributor, to widen their company´s portfolio. -Technology transfer of the new RTM process.
11. KETEK	-Knowlegement on: Adhesion promotion between resin and powder gelcoat, LCA of powder gelcoat vs liquid powder gel production, LCA of conventional RTM vs EcogelRTM processes	-Exploit modified epoxy, furanic and vinylester resin to improve gel-coat compatibility. -Exploit new LCA information/database. -Technology transfer of new process industry.
12.CIDETEC	-Improve knowledgement on the adhesion between different substrates: metal /resin; metal/thermoplastic, etc	-Exploit development of new hybrid adhesives and conductive epoxy gel-coat for electrostatic painting or other applications. -Technology transfer, educational training & consultancy services.
13.MEGARA	-Increase knowledgement on Unsaturated Polyesters for powder gel coat, Hybrid adhesives for end part assembly	-Exploit new powder gel coat –unsaturated polyester, and hybrid adhesive products in the market for RTM coated parts.(throuhgh partners´ agreements).

Therefore, based on the information given above, ECOGEL innovative technologies will **open new potential markets for the traditional RTM composite companies in Europe.**

True industrial impact will require further investment, mainly aimed to optimize: a) The industrial production of the ECOGEL electrically heated removable skins (both for the agricultural industrial equipment and the automotive sector); b) the use of those actual electrically heated removable skins use at scale-up level, making them suitable for a complete automatization process in the case of the automotive sector, and thus, also profitable for the SMEs involved in the production chain; c) ECOGEL materials: meanwhile the non-conductive powder gel coat formulation is practically ready to be used at industrial level, and the investment for the necessary equipment adjustments for mass production is not a barrier; the conductive powder gel coat formulation will require some optimization to be produced safely at industrial level, which is precisely the goal of some ECOGEL partners for 2017 (as indicated in the table).

Although the project's development is aimed at specific sectors (automotive and agricultural industrial equipment, as was agreed under Annex I of the project), the technologies developed (protected by industrial secret in some cases-e.g. for the developed resin and binder formulation ,the electrically heated skins, the non-conductive powder gel coat formulation; or by an Memorandum of Understanding, which will be used as basis for a future Exploitation Agreement, and which were signed among the directly partners involved in the development) will be able to be applied to other type of sectors, where composite materials are currently used, or are susceptible of being used (e.g. composite deposits to decrease the risk of electrostatic discharge, sanitary sector, naval industry, etc.), provided that the specific requirements of each final product can be fulfilled/adjusted from the starting characteristics of the new powder gel coat formulations and from the removable skin design developed.

All the above-mentioned sectors could be additional business for the SMEs involved in the value chain (compounders, mould manufacturers, end-users/distributors). The owners of the different results defined in the final version of the Plan for the Use and Dissemination of the Foreground will take into account these new niche market sectors.

In line with the information given above, there are also some environmental, healthy and economic impacts that have been quantified in section 1.2. –Project context and objectives.

For example, it is worthy highlighting the following positive impacts:

- Using non-conductive powder gel-coat in place of the conventional, liquid gel-coat could reduce the emission of VOCs by a factor of 30. Focusing our attention on the use phase, the total vehicle weight reduction means an estimated reduction of around 2.8 tonnes of CO_2 emissions with respect to current emissions

Savings	Fuel, litres	Global warming, kg of CO2	Costs, €
Savings per 100 km	~ 0.3	1.44	~0.78
Savings for life time (200,000 km)	1200	2800	1560

Figure1.4.1. LCA Use phase.

- The introduction of in-mould powder gel coat in the RTM composites industry will allow the increment in production rate to obtain either fully finished parts or parts ready for final electrostatic painting.
- Main advantages of powder gel coats are based on the fact that curing times are dramatically reduced and styrene emissions are removed from the workplace.
- Moreover, there are other advantages such as the fact that this is a ready-to-use formulation (no further addition of catalysts or accelerators are needed),
- the yield per square meter is higher than in a liquid gel coat (1:4) and shelf life is around one year so handling and storage is really easy.
- Additionally, conductive powder gel coat can be used as a primer for final parts painting, avoiding highly-cost secondary processes. To reach this objective, conductive powder gel coat formulations should be adapted to each process in order to enhance final surface quality.
- To be able to apply the powder gel coat, electrically conductive hot mould technologies based on laminates made of carbon-fibre- plastics were developed within the project. The results are satisfactory at this point but there exists engineering challenges to be further addressed such as increasing the durability of the mould.

- Replace steel door skin by ECOGEL composite door skin brings about important savings in global warming and energy as it is shown in figure .

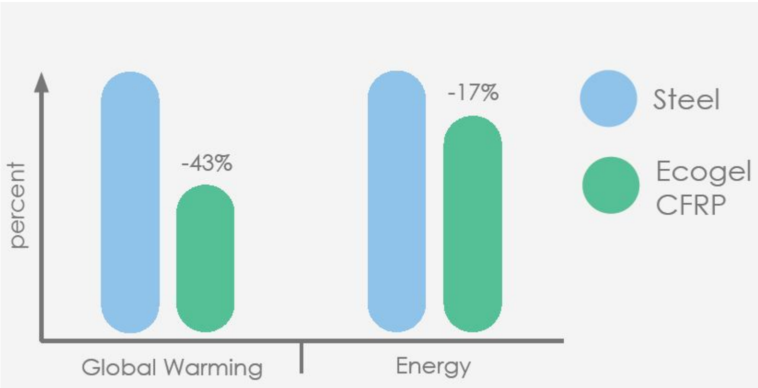


Figure 1.4.2. LCA Manufacturing phase.

Finally, it is important to highlight that the ECOGEL partners keep as an option the possibility to go on working together in this field (with related developments). For example, ECOINNOVA with AIMPLAS´ for the non-conductive formulation; AIMPLAS-SBS-MEGARA signed a MoU for the conductive one, and NETCOMP, CI and FHBI will also may collaborate in the future to improve electrically heated mould technology.

To sum up, the consortium strongly believe that there is a true potential for this novel technology to replace a large part of the existing liquid coating business and are committed to pursue this road along with any other company that may become interested in exploring such ground.

There are certainly many challenges and obstacles to be surpassed but it is ECOGEL´s consortium duty to expand the boundaries of the described technology in order to build up a more sustainable world.

1.5. Website and contact details

The ECOGEL website, *http://www.ecogelcronos.eu*, was established at the beginning of the project. Deliverable 8.27 “Project website” gives an overview of the main functionalities and structure of the website. The intended audience is double: the public at large (industry stakeholders, academia, EU and national officials, etc.) and/or the beneficiaries involved in the project, the consortium.

Technical, economic and social objectives, the expected results, and non-confidential intermediate were included. This area included a Technology Watch Service provided by AIMPLAS using the proprietary software SoftVT, which provided an update of the available patents, market information, publications, etc., issued in relation to the ECOGEL activities and that might be of interest for the ECOGEL project. After the end of ECOGEL, the web-site will be used as a useful dissemination tool for the project results.

Contact details:
AIMPLAS (Coordinator)
Tlf. +34 96 136 60 40
Fax +34 96 136 60 41
proyectos@aimplas.es

2. Use and dissemination of foreground

This document presents the plan for using and dissemination of the foreground for ECOGEL project. The plan focuses on both Dissemination and Exploitation activities.
The Dissemination plan **(section 2.1., A. PUBLIC)** includes a description of what is understood by dissemination in this context, the objectives of dissemination and the structure (activities and tools/materials).
The Exploitation strategy and activities **(section 2.1, B. CONFIDENTIAL)** gives an overview on how partners have agreed to carry out the exploitation of the project results, according to the Consortium Agreement signed by all partners and the subsequent Exploitation Strategy commitment agreed among mainly all industrial partners.
However, all the details on such Exploitation Strategy were included in the PUDF-final version (Deliverable 8.34)

SECTION A. Dissemination Measures. *PUBLIC*

In this context dissemination should be understood as a collection of activities and tasks promulgated at various levels and targeting various stakeholders, aiming wide diffusion of the research results generated by the project consortium.

The aims of this section are to describe the target audience, key dissemination tools used during the project lifetime and their execution timeframe.

2.1.1. Scope of the Dissemination – Main lines considered

The activities in the Dissemination Plan covers different audiences and channels depending on the type of information to be disseminated, in order to assure the success of the project from a strategic, environmental, technologic and economic direction based on ECOGEL´s approach.

Dissemination tools and activities could be divided in two main groups:

1. *Industrial level*: For the industrial partners, the principal objectives are to obtain results that will increase their competitiveness and market opportunities and to show these results to any potential client, in order to have a wider commercial activity and increase the company benefits. Activities such as participation in fairs, seminars, exhibitions, press releases on the new potential products…are aiming these results.
2. *Non-commercial level:* The RTD participants (AIMPLAS, CIDETEC, KETEK) and FHBI University are more focussed in non-commercial promotion and scientific aspects of the work. Only non-confidential project results are susceptible of publication or dissemination in journals, web-sites, congresses, workshops, fairs and seminars.

The dissemination actions for ECOGEL project will continue after the end of the project, looking for opportunities to further extent the knowledge acquired so far, and make possible its implementation in some way. Some scheduled examples so far can be found below:

-DONE by NETCOMP in September 2016, Final project press release, showing the last successful project results obtained.

-DONE by AIMPLAS, Technical article published in JEC Magazine (Oct/Nov 2016 issue).

-FORESEEN by AIMPLAS: Attendance to the Final event of ***FoF Concluding Event: Factories of the Future – Making Innovation Happen*** (01/12/2016)

-FORESEEN by AIMPLAS/ECOINNOVA: Workshop-non-conductive formulation (2nd semester 2017).

2.1.2. Structure of the plan – dissemination tools and activities

I. Dissemination tools

Several dissemination tools were designed and used during the ECOGEL project lifetime. The main aim of such actions was to raise awareness about project's objectives & main innovations, to develop an identity for the project. This information was also provided in the Deliverable report D8.34-Final version of the Plan for the Use and Dissemination of the Foreground.

Visual Identity

A visual identity was created for the project which includes a logo, colour scheme and a range of templates to assist with dissemination activities. The visual identity was developed in conjunction with the partners to represent a clear "brand" for the project. A strong visual identity is a key requirement to the successful dissemination of the project, creating a recognisable brand and templates to use in all dissemination activities.

Logo

The project's corporate identity allows ECOGEL to project an instantly recognisable visual image. The Project's logo is extracted from the project's name. The use of logo, represented in figure 2.1.2a., has been coherent in all publications and dissemination materials within the project. Also, the logo has been used by all partners in the written communications – templates, press releases, several project documents (minutes, agendas, official emails,...).

It is imperative for the project definition and identification purposes that no variations in terms of tones or fonts are to be used. Additionally, the use of logo by any other external party and for any purposes needs careful examination by the project's consortium.

Figure 2.1.2a **Project logo**

Colour Scheme

Primary red– RGB 237/25/33 – HEX #ED1921

Primary blue – RGB 0/173/239 – HEX #00ADEF

Primary green – RGB 0/135/80 – HEX #00A550

Dark grey – RGB 34/31/32 – HEX #221F20

Website

A project website has been developed, set-up and will be maintained throughout the project at www.ecogelcronos.eu. Its aim was to inform visitors about the project activities and be a communication tool for the partnership through the private project intranet.

The main objective of the public website was to effectively market the expected key benefits of the project to targeted market sectors. It presented these key benefits in a clear, concise manner, making appropriate use of short, non-technical descriptions, images and video.

The website will showed the project's innovative developments and clearly demonstrated their benefits to potential end users.

Figure 2.1.2b **Web page overview-FRONT PAGE**

The website also features a members-only area, for the dissemination of sensitive project documents, such as deliverable reports and EC documentation, among the partners.

Generic PowerPoint Project Presentation

A generic PowerPoint presentation was created. This presentation contains a generic and non-confidential overview of the project, which was used by members of the consortium for dissemination purposes.

Figure 2.1.2c **Generic presentation**

Project Flyers and Poster

A project flyer and poster were produced in A0, A4 and A5 formats. These were designed to give interested parties a basic overview of the project's objectives.

Figure 2.1.2d **Brochure example**

Overview Video

A simple project overview video was produced which gave an introduction to the project, its aims and objectives, why the new technology and materials need to be developed, along with details of the consortium. The video is available to view on YouTube, Vimeo and on the project's website homepage.

Figure 2.1.2f **1st video produced**

A second video was produced in the later stages of the project which gave a more technical, in-depth look at the Ecogel Cronos process and included 3D animations. Again, this video is available to view on YouTube, Vimeo and the project website.

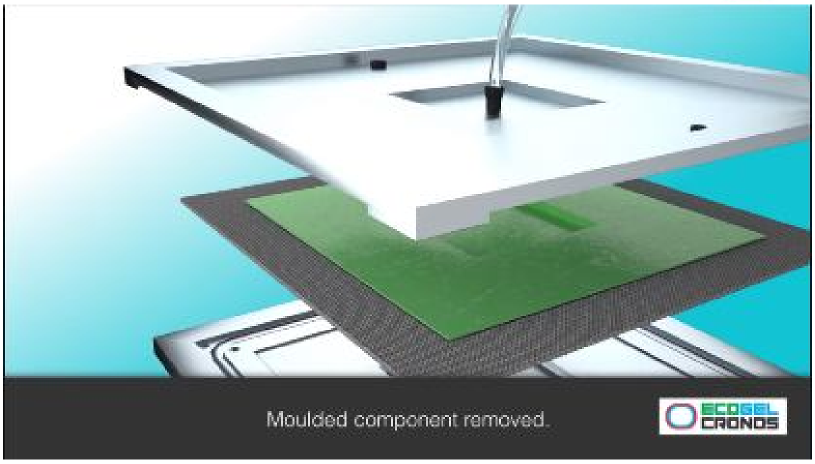


Figure 2.1.2g **2nd video produced**

Interactions with other projects, networks and technology platforms

There has already been a degree of cooperation between this project and other FP7 projects. The Ecogel Cronos consortium was very keen to take advantage of the benefits offered by "**clustering**" with other similar research projects, especially in the context of reaching out to industry. Ecogel Cronos was represented by AIMPLAS at a number of EC Impact workshops in Brussels in (such as those in March and April 2015).

ECOGEL-CRONOS identified the following projects working in a related field:

Innovative smart composite moulds for cost-effective manufacturing of plastic and composite components,

COEUS-TITAN FP7-NMP-246256 (2011-2014).

The proposed project aims to extend the applicability of composite moulds into the more demanding regime of RTM production, as well as to extend the application of the open mould and light RTM techniques in the field of advanced resin systems, where elevated temperature is required. Most important Innovations are:

i. embedded heating elements, based on the carbon reinforcement of the mould, close to the mould-part interface demanding less energy.

ii. Incorporation of flow, temperature and cure sensors that will enable full automatic control of the process.

iii. Layout of a cooling system consisting of a conformal (following the contour of the part) tubing network

iv. Use of piezoceramic film actuators which will induce micro-vibrations and assist resin flow inside the cavity

Innovative Material Synergies & Composite Processing Strategies IMS&CPS FP7-NMP- 246243 (2010-2013).

IMS&CPS will address both challenges: - by positioning of CNT at specific locations (in the reinforcing fibre, at the fibre surface and/or in the matrix) and with specific orientations as predicted by advanced engineering and innovative modelling tools for optimized properties. - by manufacturing carbon fibre reinforced polymer (CFRC) by closed mould technologies : adapted RTM, SQRTM(RTM with prepreg) and Quickset processes.

***Multifunctional Fibre Nano Composites* MUFIN**FP7-PEOPLE -322129 **(**2012-2016).

The subject of this proposal is the development of fibre-reinforced polymer (FRP) composites with mechanical properties in the high-performance range, electrical and thermal conductivities superior to those of carbon fibre composites, based on the used of macroscopic fibres made of carbon nanotubes (CNTs).

***Simulation based solutions for industrial manufacture of large infusion composite parts*.** INFUCOMP FP7-

TRANSPORT -233926 (2009-2013).

The project will develop the full simulation chain from preform design to manufacture (infusion), process/part optimisation and final part defects/mechanical performance prediction with a focus on the infusion step.

Advanced methods for an improved mould heat transfer control, ECSC-STEEL C7210-PR/272 (2001-2004)

The aim of this research to investigate and improve the mould heat transfer conditions for the continuous casting of slabs and long products by optimisation of the above-mentioned parameters. As an outcome of this research concrete process engineering measures for an improved mould heat transfer control are expected.

Press Releases

An initial press release, detailing the launch and objectives of the project was published within M1. The press release outlined the aims of the project and the project consortium members.

Further press releases were issued throughout the project to give updates on project progress and to notify people of the project's attendance at various events. A full list can be found in the Dissemination Activities Table.

Printed below is a press release issued in November 2015 regarding a technical improvement in gelcoat curing time:

> ***EU Project Ecogel Cronos Develops a New Powder Gelcoat Reducing Curing Time by Up To 80%***
>
> *The European project, Ecogel Cronos, has developed an innovative and ecological high-productivity RTM process focusing on the formulation and the manufacturing of new fast-curing powder gelcoats for composite parts.*

According to Project Manager, AIMPLAS (The Spanish Plastics Technology Centre), at this point, the manufacturing times have been drastically reduced and the emissions from the workplace have been minimised. A final finish powder gelcoat has been obtained which is claims reduces up to 80% the curing time compared to conventional liquid gelcoats. Likewise, it has been obtained a primer gelcoat with electrical conductivity in which curing time has been reduced compared to conventional ones. In this case, it is also relevant the fact that any other step in primer process is not needed.

AIMPLAS explains that until now the aerospace technology (characterised by high cost and low productivity) was used for their production. However, it is necessary to develop new technologies that make profitable the process to achieve a cost and a productivity that meet the needs of this industry.

Two study cases have been proposed in the project in order to demonstrate the advantages of the new technologies developed: a part of a tractor and a car door. After obtaining new powder gelcoats, AIMPLAS says project work is focused now on the development of composite moulds in which carbon fibre laminate will assume a double function, acting at the same time as structural reinforcement in the mould and as a heat component that will provide a completely homogenous heat surface.

The consortium of the project is formed by 13 European organisations that includes AIMPLAS, ECOINNOVA and CIDETEC from Spain; Composite Integration, AXON, FAR-UK, and NetComposites from UK; CLERIUM from the Netherlands, Indupol International from Belgium; e-Xstream engineering from Luxembourg; Bielefeld University (FHBI) from Germany; KETEK from Finland; Megara from Greece; and Steel Belt Systems Powder Coating Division (SBS) from Italy.

Another example of a press release was that issued in the latter stages of the project after it exhibited at JEC World 2016:

Ecogel Cronos Project Successfully Exhibited at JEC World 2016

The Ecogel Cronos project was successfully exhibited at JEC World 2016, the largest international composites show, on 8th - 10th March 2016, Paris Nord Villepinte.

The three day show was attended by nearly 37,000 composite industry professionals from more than 100 countries which saw over 1,300 exhibitors showcasing their products and services across 62,000 m^2 in two halls.

Ecogel Cronos will demonstrate how powder gel coats can directly replace liquid gel coats in RTM applications. It will provide tools to implement this novel material into a real production of composite parts. The coating and process offers significant reductions in VOC emissions in the RTM production plant.

This innovative product and process were displayed at JEC World, in Hall 6, Stand R52, through the following:

- *An example of the powder coating.*
- *Flat panels created using the powder coating.*
- *An RTM machine used in the process.*
- *A 1 m^2 heated skin.*

Raquel Giner Borrull, Project Manager and Coordinator from AIMPLAS, said "Replacement of liquid gel coats with powder gel coats, in the RTM industry, provides significant benefits related to economics, safety, the environment and process flexibility. Curing time of powder gel coat is reduced by up to 80% when compared to conventional liquid gel coat which will contribute to increase RTM process production ratios."

JEC Group President and CEO Mrs Frédérique Mutel commented, "...composite materials continue to become more widespread. In a world where energy savings and recyclability are sought, composites seem to stand out as one of the best answers. Innovative solutions must be found for current and upcoming challenges in terms of higher performance, lower weight, reduced costs and processing time, and of course, addressing the pressing matters of environmental concerns."

__Marketing Material__

Throughout the project various posters, flyers and postcards were produced which detailed the aims, objectives, development and outcomes of the project. The poster, flyer and postcard allowed partners to effectively dissemination the project's broad goals.

A project brochure was produced in May 2015 which included an introduction to the project, its scientific and technical objectives and progress to date.

Figure 2.1.2h **Different marketing materials**

During the later stages of the project some flyers and a booklet were produced giving details of the agricultural equipment part and door skin case studies.

Figure 2.1.2i **Flyers and booklet used in Composite Innovation 2016 event**

An infographic which gave details of the life cycle assessment for the automotive case study.

Figure 2.1.2j **Infographic used in Composite Innovation 2016 event**

Exhibitions / Conferences and Workshops

Ecogel Cronos project partners have attended many conferences, exhibitions and workshops throughout the duration of the project where its aims, objectives and outcomes have been disseminated – see the full list in section 3.

Towards the end of the project, Ecogel Cronos has had a major presence in two exhibitions/conferences, JEC World 2016 and Composites Innovation 2016 with an exhibition stand at each, showing the technology developed, materials manufactured, and parts made. Both exhibition stands featured videos giving an overview of the project and more detailed information on specific technologies.

JEC World 2016

The Ecogel Cronos project was successfully exhibited at JEC World 2016, the largest international composites show, on 8th - 10th March 2016, Paris Nord Villepinte.

The three day show was attended by nearly 37,000 composite industry professionals from more than 100 countries which saw over 1,300 exhibitors showcasing their products and services across 62,000 m2 in two halls.

The process and prototype parts were displayed at JEC World 2016, in Hall 6, Stand S49, through the following:

- An example of the powder coating.
- Flat panels created using the powder.
- An RTM machine used in the process.
- A 1m^2 heated skin.

JEC Group President and CEO Mrs Frédérique Mutel commented, "...composite materials continue to become more widespread. In a world where energy savings and recyclability are sought, composites seem to stand out as one of the best answers. Innovative solutions must be found for current and upcoming challenges in terms of higher performance, lower weight, reduced costs and processing time, and of course, addressing the pressing matters of environmental concerns."

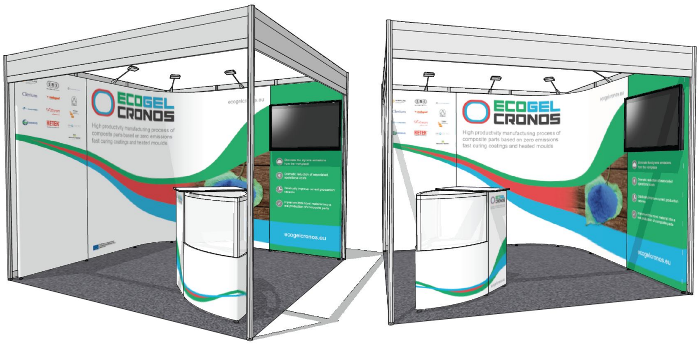


Figure 2.1.2k Mockups of the exhibition stand design

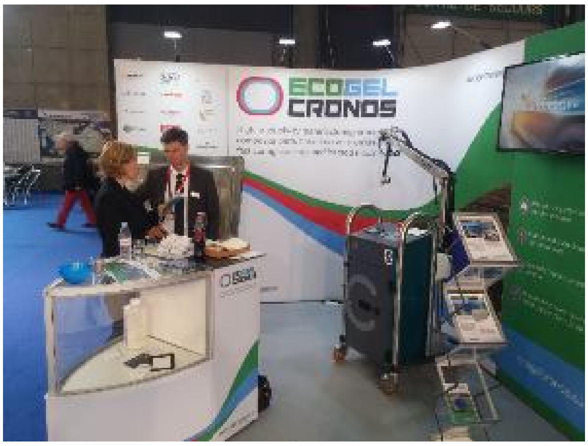


Figure 2.1.2l Visitors to the ECOGEL CRONOS stand at JEC World

A range of marketing collateral has been produced including a project "brochure" which gives and introduction to the project and showcases the contribution by each partner; a datasheet which gives information on the demonstrator parts; and a map of all partners exhibiting at JEC World.

Figure 2.1.2m Booklet and Visitors map, used in JEC WORLD 2016

A press release was also issued highlighting project progress and inviting people to visit the stand at JEC World.

Composites Innovation 2016

The Ecogel Cronos project generated much interest with its innovative powder gelcoat and heated mould technologies at Composites Innovation 2016, 22-23rd June 2016, Sheffield, UK with talks from project partners and an exhibition stand including samples and parts made within the project.

The talks will were:

- Recent Advances in Powder Coating Technology for use in the RTM Process – Fátima Almulla, Ecoinnova and Raquel Giner Borrull, AIMPLAS
- Manufacturing Large Composite Structures by Direct Infusion - Stephen Leonard-Williams, Composites Integration

Figure 2.1.2n Attendees included end users, OEM's and individuals.

II. Dissemination activities

It is essential to highlight that an extensive dissemination activities were activated and completed during the development of ECOGEL. The project information was disseminated via three channels:

a) By partners, within their organizations (e.g. internal newsletters, meetings, seminars, training courses, etc.)
b) By partners, during external events (e.g. fairs, conferences, networking events, workshops, etc.)
c) By partners, using media across Europe (e.g. press release, Internet, specialized magazines, etc.)

The use of various channels and methods (written, face-to-face & online) assured an optimal contribution of coverage, visibility and most important- setting up the scene for better market acceptance in the near future.

Tables below show the dissemination activities (publications, conferences, workshops, web, press releases, brochures, etc.) held by project partners during the whole ECOGEL project duration.

Project Dissemination Activities

Nº	Type of activities	Main leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Press releases	ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS - AIMPLAS	(AIMPLAS desarrolla un) novedoso gel coat en polvo para el curado más rápido y eficiente de composites	11/11/2013	Technical websites (Interempresas, Mundoplast, Plast 21-IZARO, Plástico y Caucho, R& D AIMPLAS bulle	Industry		All Spanish Speaking
2	Web sites/Applications	ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS - AIMPLAS	Desarrollamos un novedoso recubrimiento para un secado más rápido y económico de los composites gracias al proyecto ECOGEL	13/11/2013	Social netwroking (AIMPLAS Facebook, Twitter, Linkedin)	Civil society		All Spanish Speaking
3	Articles published in the popular press	ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS - AIMPLAS	RTM en el sector de la automoción	08/04/2014	Interempresas-Plástico y Caucho	Industry		All Spanish Speaking
4	Organisation of Workshops	ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS - AIMPLAS	FoF Workshop 2014	24/03/2014	Brussels-Belgium (EU facilities)	Scientific community (higher education, Research) - Industry	60	EU Countries
5	Exhibitions	COMPOSITE INTEGRATION LTD	Composite Engineering Show	11/11/2014	NEC Birmingham, UK	Industry		UK
6	Flyers	AXON AUTOMOTIVE LIMITED	ECOGEL-CRONOS postcard and leaflet	11/11/2014	The NEC in Birmingham for the Advanced Engineering Show	Industry		UK, Italy
7	Press releases	NETCOMPOSITES LIMITED	NetComposites are attending the first meeting of the Ecogel Cronos project in Brussels	18/09/2013	NetComposites Technology News	Scientific community (higher education, Research) - Industry		Worldwide
8	Press releases	NETCOMPOSITES LIMITED	NetComposites attended the second meeting of the Ecogel Cronos project in Brussels	11/12/2013	NetComposites Technology News	Scientific community (higher education, Research) - Industry		Worldwide

9	Press releases	NETCOMPOSITES LIMITED	NetComposites has recently taken delivery of a new RTM mould tool	21/01/2014	NetComposites Technology News	Scientific community (higher education, Research)		
10	Organisation of Workshops	AIMPLAS - ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS	Cluster A3.2.5 workshop	13/03/2015	Paris, France	Scientific community (higher education, Research) - Industry	25	
11	Flyers	AIMPLAS - ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS	Unknown	30/09/2015	Unknown	Scientific community (higher education, Research) - Industry		
12	Organisation of Conference	COMPOSITE INTEGRATION LTD	JEC Europe Composites Show	10/03/2015	Paris Porte de Versailles, Paris France	Industry		
13	Web sites/Applications	COMPOSITE INTEGRATION LTD	Ecogel Cronos Page - CI Website	05/03/2015	CI	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		
14	Press releases	CLERIUM	Company Newsletter	15/03/2015	e-mail	Industry	50	
15	Flyers	CLERIUM	Flyers to known contacts	15/03/2015	Jec, Paris	Industry	20	
16	Flyers	CLERIUM	Flyers to known contacts	15/09/2015	Stuttgart, Gemany	Industry	20	
17	Web sites/Applications	INDUPOL INTERNATIONAL N.V.	photo's of first prototypes of Daf Side skirt	15/09/2015	Arendonk	Civil society		
18	Organisation of Conference	AXON AUTOMOTIVE LIMITED	Advanced Engineering Show	11/11/2014	The NEC in Birmingham	Scientific community (higher education, Research) - Industry	1000	
19	Organisation of Conference	AXON AUTOMOTIVE LIMITED	AMSCI CiC - Open Day	29/04/2015	Coventry	Scientific community (higher education, Research) - Industry	150	
20	Organisation of Conference	AXON AUTOMOTIVE LIMITED	JEC Paris 2016	08/03/2016	Paris, France	Scientific community (higher education, Research) - Industry	10000	UK
21	Organisation of Conference	AXON AUTOMOTIVE LIMITED	Composites Innovation	22/06/2016	Sheffield	Scientific community (higher education, Research) - Industry	150	UK
22	Press releases	NETCOMPOSITES LIMITED	EU Project Ecogel Cronos Develops a New Powder Gelcoat Reducing Curing Time by Up To 80%	24/11/2015	NetComposites News	Industry	45000	Worldwide
23	Press releases	NETCOMPOSITES LIMITED	Ecogel Cronos to Showcase Innovative Environmentally Friendly Gel Coat Process at JEC World	01/03/2016	NetComposites News	Industry	45000	Worldwide
24	Press releases	NETCOMPOSITES LIMITED	Ecogel Cronos Project Successfully Exhibited at JEC World 2016	01/03/2016	NetComposites News	Industry		Worldwide
25	Videos	NETCOMPOSITES LIMITED	Project Overview	15/06/2015	YouTube, Vimeo, project website	Scientific community (higher education, Research) - Industry		Worldwide
26	Videos	NETCOMPOSITES LIMITED	RTM process	15/11/2015	YouTube, Vimeo, project website	Scientific community (higher education, Research) - Industry		Worldwide
27	Organisation of Conference	NETCOMPOSITES LIMITED	JEC World 2016	10/03/2016	Paris, France	Scientific community (higher education, Research) - Industry	37000	Worldwide
28	Organisation of Conference	NETCOMPOSITES LIMITED	Composites Innovation	22/06/2015	Sheffield	Scientific community (higher education, Research) - Industry	100	Worldwide
29	Web sites/Applications	E-XSTREAM ENGINEERING SARL	e-Xstream Project Page with results	15/03/2015	.	Scientific community (higher education, Research) - Industry		Worldwide

30	Flyers	E-XSTREAM ENGINEERING SARL	e-Xstream case study related to the project	15/06/2015	.	Scientific community (higher education, Research)		Worldwide
31	Organisation of Workshops	E-XSTREAM ENGINEERING SARL	e-Xstream User 's Meeting	15/10/2015	.	Scientific community (higher education, Research) - Industry	100	Worldwide
32	Organisation of Workshops	FACHHOCHSCHULE BIELEFELD	Workshop Ecogel Cronos	22/05/2014	FH Bielefeld	Industry	6	Europe
33	Press releases	FACHHOCHSCHULE BIELEFELD	Article regarding above workshop on FH Bielefeld Website	27/05/2014	FH Bielefeld	Scientific community (higher education, Research)		Germany
34	Videos	FACHHOCHSCHULE BIELEFELD	Heated Mould From A-Z (not yet determined)	05/06/2014	FH Bielefeld	Industry		Germany/other
35	Posters	FACHHOCHSCHULE BIELEFELD	Departmend Year Review	01/03/2016	FH Bielefeld	Industry		Germany
36	Organisation of Conference	FACHHOCHSCHULE BIELEFELD	Composite Innovation	22/06/2016	Sheffield	Scientific community (higher education, Research) - Industry		Worldwide
37	Web sites/Applications	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	Ecoinnova Website	15/03/2015	Web	Industry		Worldwide
38	Exhibitions	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	JEC	09/03/2014	Paris, France	Industry		Europe
39	Exhibitions	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	Composites Europe	15/10/2014	Essen	Industry		Europe
40	Oral presentation to a scientific event	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	Technology Transfer plan	15/12/2014	Valencia	Industry	25	Europe
41	Articles published in the popular press	ECOINNOVA TERMOESTABLES SOCIEDAD LIMITADA	Description of gel coats with zero emissions	01/07/2015	Specialised Composites Magazine	Industry		Worldwide
42	Flyers	Teknologiakeskus KETEK Oy	Kokkola Material Week 2014	23/06/2014	Kokkola	Scientific community (higher education, Research) - Industry	370	Worldwide
43	Posters	Teknologiakeskus KETEK Oy	20th International Conference on Composite Materials, ICCM20	19/07/2015	Copenhagen, Denmark	Industry	500	Worldwide
44	Flyers	Teknologiakeskus KETEK Oy	Composite days 2013	14/11/2013	Kokkola, Finland	Scientific community (higher education, Research) - Industry	90	Finland
45	Exhibitions	FUNDACION CIDETEC	JEC 2014	11/03/2014	Paris, France	Scientific community (higher education, Research) - Industry	36000	Europe
46	Videos	FUNDACION CIDETEC	IK4-CIDETEC	11/03/2014	Web	Scientific community (higher education, Research) - Industry - Policy makers - Medias		Worldwide
47	Press releases	FUNDACION CIDETEC	Novedoso proceso de fabricación de composites de alta cadencia de producción, basado en gel-coat en polvo para el curado más rápido y eficiente	11/03/2014	Empresa XXI	Civil society		Spain
48	Web sites/Applications	FUNDACION CIDETEC	A new composite manufacturing process to reduce production times.	14/03/2014	Web	Scientific community (higher education, Research) - Industry - Policy makers - Medias		Worldwide
49	Exhibitions	FUNDACION CIDETEC	AIRTEC 2014	28/10/2014	Frankfurt	Scientific community (higher education, Research) - Industry	5200	Europe
50	Exhibitions	VIOMICHANIA RITINON MEGARON ANASTASIOS FANIS ANONYMOS ETAIRIA	European Coatings Show: participation as exhibitors	21/04/2015	Nuremberg	Industry	25000	Worldwide
51	Flyers	VIOMICHANIA RITINON MEGARON ANASTASIOS FANIS ANONYMOS ETAIRIA	European Coatings Show: participation as exhibitors	21/04/2015	Nuremberg	Industry	25000	Worldwide
52	Posters	VIOMICHANIA RITINON MEGARON ANASTASIOS FANIS ANONYMOS ETAIRIA	European Coatings Show: participation as exhibitors	21/04/2015	Nuremberg	Industry	25000	Worldwide
53	Web sites/Applications	VIOMICHANIA RITINON MEGARON ANASTASIOS FANIS ANONYMOS ETAIRIA	European Research Projects section of Megara website	15/05/2015	Web	Industry		Europe / Worldwide

***The same information but in a 'list' format is included in the EC reporting system, section Dissemination Activities.*

Below each project partner has provided a summary of their activities and an overview of each event they attended or plan to attend during the project. *There is only one scientific publication, which corresponds to FHBI, but it has not been possible to be added to the EC system.*

AIMPLAS

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Press release	(AIMPLAS desarrolla un) novedoso gel coat en polvo para el curado más rápido y eficiente de composites [Based on the 1st press release]	11, 12, 14, 25/11/2013	Technical websites (Interempresas, Mundoplast, Plast 21-IZARO, Plástico y Caucho, R& D AIMPLAS bulletin, Technological Watch Service, REDIT website)	Industry	worldwide (in Spanish)	Spanish-speaking
Websites / applications	Desarrollamos un novedoso recubrimiento para un secado más rápido y económico de los composites gracias al proyecto ECOGEL	13/11/2013	Social netwroking (AIMPLAS Facebook, Twitter, Linkedin)	Civil society	worldwide (in Spanish)	Spanish-speaking
Articles published in popular press	RTM en el sector de la automoción	08/04/2014	Interempresas-Plástico y Caucho	Industry	worldwide (in Spanish)	Spanish-speaking
Workshop	FoF Workshop 2014	24-25/03/2014	Brussels-Belgium (EU facilities)	Scientific/industry	60	EU level
Cluster workshop	Cluster A3.2.5 workshop	13/03/2015	Paris (France)	Scientific/industry	25	EU level
Technical article and/or poster	unknown	3rd-4th quarter 2015	unknown	Scientific/industry	EU/WW	Spanish and English

Name of event:	Impact of the Factories of Future PPP
Date:	24-25/03/2014
Location:	Brussels, Belgium (Centre Albert Borschette, rue Froissart 36, Brussels & MADO Auditorium, Place Madou 1,

	Brussels)
Overall aim of the event:	To foster clustering activities among the projects related to the same topic/area (in this case Area 3,2,5,). Netwroking not only for future proposals, but what it is more important, for ensuring greater exploitation of the results from a common view/work.
Short summary of event:	Coordinators of the projects within the FoF PPP showed their clustering activities (ongoing/to be started). The next day there was a discussion on how maximising impact and successful innovation strategy
How was the project disseminated at the event:	One slide on the project objectives, impact and partners,within the topci area of the call where it was submitted
Any follow-up actions	Becoming member of the sub-cluster of plastic within Area 3,2,5, & be part of the exchange of synergies in the other sub-clusters defined (metallic). Future actions to be defined

Composites Integration

Type of activity (drop down box)	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Conference	Composite Engineering Show	11/11/2014	NEC Birmingham	Industry	unknown - large	
Conference	JEC Europe Composites Show	10/03/2015	Paris Porte de Versailles	Industry	unknown - large	
Websites / applications	Ecogel Cronos Page - CI Website	05/03/2015	CI	All	unknown - large	

Name of event:	Composite Engineering Show – NEC
Date:	11-12th November 2014
Location:	NEC, Birmingham, United Kingdom
Overall aim of the event:	To look for any technologies, materials, or manufacturing techniques that could assist with project tool build.
Short summary of event:	Engineering show and open conference. Two day event in which composite engineering companies can exhibit.

How was the project disseminated at the event:	Discussion with visitors to the Composite Integration stand.
Any follow-up actions	n/a

Name of event:	JEC Europe Composites Show
Date:	10-12th March 2015
Location:	Paris Porte de Versailles, Paris, France
Overall aim of the event:	To look for any technologies, materials, or manufacturing techniques that could assist us with our project tool build.
Short summary of event:	Engineering show and open conference. Networking platform, knowledge sharing.
How was the project disseminated at the event:	Discussion with visitors to the Composite Integration stand.
Any follow-up actions	n/a

Name of event:	Ecogel Cronos Page - CI Website
Date:	5th March 2015
Location:	CI
Overall aim of the event:	To show CI is working within the project.
Short summary of event:	Webpage with brief overview of project.
How was the project disseminated at the event:	Visitors to the Webpage.
Any follow-up actions	Inquiries from visitors to the page.

Clerium

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Press release	Company newsletter	march 2015	e-mail	Industry	50	NL, D, B, UK, FR, GR, SP
Flyers	Flyers to known contacts	march 2015	JEC, Paris	Industry	20	NL, D, B, UK, FR, GR, SP
Flyers	Flyers to known contacts	sept. 2015	Stuttgart	Industry	20	NL, D, B, UK, FR, GR, SP

Indupol

Type of activity (drop down box)	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Presentations	Ecogel project	Jun-15	Eindhoven	DAF/PACCAR people	5	BENELUX
Websites / applications	photo's of first prototypes of Daf Side skirt	Sep-15	Arendonk	by Twitter/website	?	WW

Name of event:	Technical discussion with Engineering and purchasing DAF
Date:	01/06/2015
Location:	Eindhoven
Overall aim of the event:	Prepare the product evaluation by DAF/PACCAR

Name of event:	photo's of first prototypes of Daf Side skirt
Date:	01/09/2015
Location:	Indupol Arendonk

Overall aim of the event:	Show the first prototypes in this innovative production technique to potential customers

Axon

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Flyers	ECOGEL-CRONOS postcard and leaflet	11/11/14 and 12/11/14	The NEC in Birmingham for the Advanced Engineering Show	People from the automotive and composites industry	Industry and Scientific	UK and Italy
Conference	Advanced Engineering Show	11th November 2014	NEC, Birmingham	Scientific, Industry	more than 1,000	United Kingdom
Conference	AMSCI CiC - Open Day	29th April 2015	Coventry	Scientific, Industry	about 150	France
Conference	JEC Paris 2016	8th-10th March 2016	Paris	Scientific, Industry	about 10,000	United Kingdom
Conference	Composites Innovation	22nd June 2016	Sheffield	Scientific, Industry	about 150	United Kingdom

NetComposites

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Press release	NetComposites are attending the first meeting of the Ecogel Cronos	18/09/2013	NetComposites Technology			World

	project in Brussels		News			
Press release	NetComposites attended the second meeting of the Ecogel Cronos project in Brussels	11/12/2013	NetComposites Technology News			World
Press release	NetComposites has recently taken delivery of a new RTM mould tool	21/01/2014	NetComposites Technology News			World
Press release	EU Project Ecogel Cronos Develops a New Powder Gelcoat Reducing Curing Time by Up To 80%	24th Nov 2016	NetComposites News	Industry	45,000/month	Worldwide
Press release	Ecogel Cronos to Showcase Innovative Environmentally Friendly Gel Coat Process at JEC World	1st March 2016	NetComposites News	Indsutry	45,000/month	Worldwide
Press release	Ecogel Cronos Project Successfully Exhibited at JEC World 2016	March 2016		Industry		
Video	Project Overview	June 2015	YouTube, Vimeo, project website	Industry, scientifc		Worldwide
Video	RTM process	November 2015	YouTube, Vimeo, project website	Industry, scientifc		Worldwide
Conference	JEC World 2016	March 2016	Paris	Industrial, scientific	37,000	Worldwide
Conference	Composites Innovation 2016	June 2016	Sheffield, UK	Industrial, scientific	100	Worldwide

e-Xtreme

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Websites / applications	e-Xstream Project Page with results	From March 2015		Scientific, Industry		world
Flyers	e-Xstream case study related to the project	June 2015		Scientific, Industry		world
Workshop	e-Xstream User 's Meeting	October 2015	Not yet decided	Scientific, Industry	100	world

Bielefeld

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Workshop	Workshop Ecogel Cronos	22/23.05.14	FH Bielefeld	Project Partners	6	EU Project Partners
Press release	Articel regarding above workshop on FH Bielefeld Website	27/05/2014	FH Bielefeld	Students/Employees/Public Website Guests	unknown	Germany
Videos	Heated Mould From A-Z (not yet determined)	unknown	FH Bielefeld	Project Partners/Internal Use	unknown	Germany/other
Publication	Departmend Year Review	early 2015	FH Bielefeld	Industy Partners/Employees	unknown	Germany
Posters	Unknown	unknow	FH	Unknown	unknown	Unknown

		n	Bielefeld			
Presentations	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Exhibitions	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Publication	Ressourcen & Rohstoffe : Forschung erhält unseren Lebensraum	June 2016	ISBN: 978-3-9816422-3-0	Scientific	unknown	Germany
Conference	Composite Innovation	22-23.June 2016	Sheffield	Scientific and Industry	Unknwon	Worldwide

Name of event:	Workshop Ecogel Cronos
Date:	22/23 May 2014
Location:	U A S Bielefeld
Overall aim of the event:	Giving the participants the ability to build heated mould on theyr own.
Short summary of event:	The participants were given an introduction on calculating and building heated moulds according to the fibretemp patent.
How was the project disseminated at the event:	Free workshop with participants from the consortium.
Any follow-up actions	possibility to make further workshops for consortium members who did not take part.

Name of event:	Website Article on FH-Bielefeld.de
Date:	27/05/2014
Location:	Bielefeld

Overall aim of the event:	Press relase on Department Activities
Short summary of event:	Press relase regarding previously mentioned workshop on Heated Moulds with fibretemp
How was the project disseminated at the event:	Unknown
Any follow-up actions	none

Name of event:	Heated Mould From A-Z (not yet determined)
Date:	unknown
Location:	FH Bielefeld
Overall aim of the event:	Documentation on how to build a heated mould.
Short summary of event:	Build Documentation on how to build a heated mould.
How was the project disseminated at the event:	unknown
Any follow-up actions	Consortium internal Video Workshop or Customer information could be possible.

Name of event:	Departmenr Year Review 2014
Date:	unknown/ not yet released / Early 2015
Location:	FH Bielefeld
Overall aim of the event:	Informing U A S Bielefelds Industypartners about the activites of the department IuM.
Short summary of event:	Yearbook with all resarch activities in our department.

How was the project disseminated at the event:	Unknown
Any follow-up actions	none

Name of event:	Publication: Ressourcen & Rohstoffe : Forschung erhält unseren Lebensraum
Date:	June 2016
Location:	ISBN: 978-3-9816422-3-0
Overall aim of the event:	Information about research activities at Universities in North Rhine Westfalia
Short summary of event:	Article in printed publication
How was the project disseminated at the event:	Article
Any follow-up actions	none

Name of event:	Conference Composite Innovation
Date:	22-23-6-2016
Location:	Sheffield, UK
Overall aim of the event:	Conference about Automation in Composite Industry
Short summary of event:	
How was the project disseminated at the event:	Stand with the other Project-Partners Exhibiting Demonstrators built in the project
Any follow-up actions	none

Ecoinnova

Type of activity	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Websites / applications	Ecoinnova Website	Sep-14	Web	Industry	Worlwide	Worlwide
Exhibitions	JEC	March 2014	Paris	Industry	20 companies	Europe
Exhibitions	Composites Europe	Oct-14	Essen	Industry	10 companies	Europe
Presentations	Technology Transfer plan	Dec 2014	Valencia	Cosortium	13 companies	Europe
Publication	Description of gel coats with zero emissions	July 2015	Specialised Composites Magazine	Industry	Worldwide	Worldwide

Name of event:	EcoInnova Website
Date:	Sep-14
Location:	Web
Overall aim of the event:	Promote EcoGel Cronos Technology
Short summary of event:	Description of main objectives to complete within EcoGel Cronos Project
How was the project disseminated at the event:	Via WebSite
Any follow-up actions	Updating with more informations as the project progresses

Name of event:	JEC
Date:	March 2014
Location:	Paris
Overall aim of the event:	Promotion of EcoInnova's activities at this renown international exhibition highlighting the tehcnological background of the EcoGel Cronos Project
Short summary of event:	Meeting with several European companies involved in the RTM technology
How was the project disseminated at the event:	Personal Meetings
Any follow-up actions	We will attend the show in 2015

Name of event:	Composites Europe
Date:	Oct-14
Location:	Essen
Overall aim of the event:	Promotion of EcoInnova's activities at this renown international exhibition highlighting the tehcnological background of the EcoGel Cronos Project
Short summary of event:	Meeting with several European companies involved in the RTM technology
How was the project disseminated at the event:	Personal Meetings
Any follow-up actions	We will attend the show in 2015

Name of event:	Technology Transfer Plan for Ecogel Cronos project
Date:	Dec 2014
Location:	Valencia
Overall aim of the event:	Defining the main actions for efficient transfer of technology within the consortium

Short summary of event:	Power point presentation with key points describing the technology transfer paln for EcoGel Cronos Project
How was the project disseminated at the event:	Power Point presentation sent to NetComposites
Any follow-up actions	Monitoring the transfer of knowledege amongst partners in the consortium

Title of article	Main author	Title of overall publication	How often published	Publisher	Where published	Date of publication	Page numbers	Is it open access
Description of gel Coats with zero emissions	F.Castro		Monthly	JEC Magazine	JEC Magazine	July 2015	TBD	Yes

KETEK

Type of activity (drop down box)	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Flyers	Composite days 2013	14-15.11.2013	Kokkola, Finland	scientific, indystry	90	Finland
Workshop	Workshop Ecogel Cronos	22/23.05.14	FH Bielefeld	Project Partners	6	EU Project Partners
Flyers	Kokkola Material Week 2014	23-26.09.2014	Kokkola	Research, industry, students	370	Worldwide
Cluster workshop	Cluster A3.2.5 workshop	13/03/2015	Paris (France)	Scientific/industry	25	EU level
Posters	20th International Conference on Composite Materials, ICCM20	19-24.07. 2015	Denmark, Copenghagen	Research, industry	1700	Worldwide

Conference	Composite Innovation	22-23.June 2016	Sheffield	Scientific and Industry	100	Worldwide

Name of event:	Lujitemuovipäivät 2013 /Composite days 2013
Date:	14-15.2013
Location:	Kokkola
Overall aim of the event:	Annual event for Finnish Composite industry
Short summary of event:	Around 100 participants from industry and academia usually participates in the event. New materials, technologies and also product development case studies are the main themes of the event.
How was the project disseminated at the event:	Flyers were shared as well as face to face discussions with participants of the event
Any follow-up actions	

Name of event:	Kokkola Material Week 2014
Date:	23-26.09.2014
Location:	Kokkola, Finland
Overall aim of the event:	This is the opportunity for business developers and scientists to network and learn more about material science.
Short summary of event:	In the conference program international experts presented within six thematic sessions: biokokkola, greenkokkola, metalkokkola, leatherkokkola, rekokkola. This was a unique chance to update knowledge and meet experts with the same passionate interest for chemistry and materials. Every session included at least one presentation about how to do business with new technology.
How was the project disseminated at the event:	project flyers were distrubuted for participants
Any follow-up actions	

Name of event:	20th International Conference on Composite Materials, ICCM20
Date:	19-24 July, 2015
Location:	Denmark, Copenghagen
Overall aim of the event:	The overall theme for the ICCM20 will be “Sustainable Composite Solutions to Global Challenges”, which reflects the very important role that composite materials have in developing future sustainable low carbon foot print and low CO2 emission technologies that are so essential and a prerequisite for providing the basis for further development and improvement of the living conditions of the people of the world.
Short summary of event:	The themes chosen for ICCM20 will cover all relevant aspects of the science and technology of composite materials included in but not limited to the overall professional theme areas of Nanocomposites, Structures and Design, Damage and Failure, Fatigue, Dynamic Effects, Novel Material Systems, Experimental Characterization, Health/Condition Monitoring, Smart/adaptive Material Systems, Manufacturing, Applications as well as covering special sessions within education/skills/training and technology transfer.
How was the project disseminated at the event:	poster will be made for the conference if the abstact is approved
Any follow-up actions	

CIDETEC

Type of activity (drop down box)	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Exhibitions	JEC 2014	11/03/2014-13/03/2014	Paris	Scientific, Industry	36000	Europe
Videos	IK4-CIDETEC		http://www.cidetec.es/cas/nanomateriales.aspx	Scientific, Industry, policy makers and	Internet	Worldwide

				media		
Press release	Novedoso proceso de fabricación de composites de alta cadencia de producción, basado en gel-coat en polvo para el curado más rápido y eficiente		Empresa XXI	Civil society	Internet	Spain
Websites / applications	A new composite manufacturing process to reduce production times.	14/03/2014	http://www.cidetec.es/en/noticia.aspx?origen=sala_prensa&id=7cd74390-a807-41b4-b2ac-0a98f25fb2e2&pagina=0	Scientific, Industry, policy makers and media	Internet	Worldwide
Exhibitions	AIRTEC 2014	28/10/2014-30/10/2014	Frankfurt	Scientific, Industry	5200	Europe

Megara

Type of activity (drop down box)	Title	Date	Place	Type of audience	Size of audience	Countries addressed
Exhibitions	European Coatings Show: participation as exhibitors	21-23/04/2015	Nuremberg	Visitors/ Exhibitors	ECS 2013 had 25845 visitors	Worldwide
Conference	11th Hellenic Polymer Society International Conference	3-5 November 2016	Heraklion, Crete, Greece	Scientific, Industry	not yet defined, expected over 2000	Worldwide
Flyers	European Coatings Show: participation as exhibitors	21-23/04/2015	Nuremberg	Visitors/ Exhibitors	ECS 2013 had 25845 visitors	Worldwide
Posters	European Coatings Show: participation as exhibitors	21-23/04/2015	Nuremberg	Visitors/ Exhibitors	ECS 2013 had 25845 visitors	Worldwide
Websites / applications	European Research Projects section of Megara website	Permanently for the duration of the project	Company website: www.megararesins.com	N/A	N/A	European Union, Worldwide

Name of event:	European Coatings Show
Date:	21-23 April 2015
Location:	Nuremberg, Germany
Overall aim of the event:	Megara will exhibit its product range, as well as its R&D projects.
Short summary of event:	Not available as of yet.

How was the project disseminated at the event:	Dissemination plan consists a poster presentation and flyers, presenting the aims and partners of Ecogel Cronos project and focussing on overall contribution of Megara Resins to the project.
Any follow-up actions	Not as of yet.

Name of event:	European Research Projects subesection of Megara Resins company website
Date:	Since the start date of the project
Location:	Company website : www.megararesins.com
Overall aim of the event:	Disseminate Ecogel Cronos project in and Megara Resins participation.
Short summary of event:	Webpage contains the title and the abstract of the project, as well as other relevant information about the project.
How was the project disseminated at the event:	N/A
Any follow-up actions	Not as of yet.