PROJECT NO: FP6-018164

EMISHIELD

A Novel Gasket and Seal System used for EMI Shielding Using Double Percolation of Carbon Nanotube Technology to Improve Safety, Profitability and Productivity

Co-operative Research (Craft)

Horizontal Research Activities Involving SMEs

DELIVERABLE 29

Final Activity Report – Reporting Period 1 and 2

Start Date: 1st September 2005 Duration: 30 Months

Lead Contractor: Roxtec International AB Version 1

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Project Information

Project No: FP6-018164

Contractor No: COOP-CT-2005-018164

Title of Project: EMISHIELD - A Novel Gasket and Seal System used for EMI Shielding Using Double Percolation of Carbon Nanotube Technology to Improve Safety, Profitability and Productivity

Coordinator: Joakim Hellkvist

SME Exploitation Manager: Roxtec International AB

SME Contractors:

1 ROXTEC INTERNATIONAL AB
2 DKI PLAST AS
3 PER-FANGE-LARSEN
4 PIONET SP. Z.O.O.
5 TECNICA EN INSTALACIONES DE FLUIDOS S.L.
9 BEKINA

Other Enterprise / End User Contractors:

6 ABB POWER TECHNOLOGIES AB

RTD Performer contractors:

7 PERA INNOVATION LTD
8 CRIF-WALLONIE

Foreword

This document is for the CRAFT project known as “A Novel Gasket and Seal System used for EMI Shielding Using Double Percolation of Carbon Nanotube Technology to Improve Safety, Profitability and Productivity – EMISHIELD”.

The project is founded by the European Union.

Project title: “A Novel Gasket and Seal System used for EMI Shielding Using Double Percolation of Carbon Nanotube Technology to Improve Safety, Profitability and Productivity” - EMISHIELD

Project Acronym: EMISHIELD

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Version number	Date	Author(s)	Description
1	24/06/2008	Sébastien Allibe	Initial Draft

PUBLISHABLE EXECUTIVE SUMMARY

This report covers the work carried out in the second period of the Emishield project.

The main body of this report is a précised overview. However, more detailed appendices are attached to cover the technical work program.

The Emishield project proposes to develop a novel gasket and seal system used for EMI shielding. The new system will reduce the time for installation and maintenance and dampen 85 dB. Furthermore the system will sustain 6 bars water tightness and 4 bars gas tightness.

After the commencement of the project, it was discussed that some of the work needed to be reviewed, this according to discussions after the 3-months meeting. Prior to the 3-months meeting, it was seen that the proposed PC/PE polymer material didn't have the required properties, and therefore a new material had to be found. The consortium found it necessary to perform a few minor adjustments in the work description in the annex 1. The review affected work package 1, 2 and 3, which cover the scientific studies, the development of CNT enhanced PC/PE composite, and the development of a flexible CNT PC/PE extruded film. The new tasks cover the scientific understanding of conductivity in different grades of fillers, scientific understanding of double percolation development of correct compounding technique and development of a new gasket design. The work described in the rest of the document will be referred to the reviewed work program.

Progress has been good in a number of tasks; good links have been made, especially with the new partner Bekina that joined the consortium after the project start. They have been highly involved and have contributed a lot to the success in the project.
The first trials were initially delayed due to change of matrix material and problems finding the right equipment and process parameters for the new polymer.

The project is progressing and the planned schedule has been partly changed to better reflect the predicted timescales of the tasks based on the knowledge that has been gained during the first part of the project. All meetings have been well attended and the partners have been actively involved in the research work.

The project has created a web site for the combined use of an on-line administrative tool for the partners (password protected) and web presence. The web site can be seen via http://emishield.pera.com. The public project summary can be viewed by selecting "The project summary is here" in the bottom of the web site.

section 1 – PROJECT OBJECTIVES & MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD

1.1 Overview of General Project Objective

The overall objective of our work is to develop a novel gasket and seal system used for EMI shielding. The new system should reduce the time for installation and maintenance and effectively shield for EMI. Furthermore the system should have good water and gas tightness.

Installation – Develop a product that is produced by fewer parts compared with to-days sealing and gasket product to reduce at least 20% the time spent on use, maintenance and installation. In addition the product will be offered to a total cost of less than €200 per unit to the SME EMI shielding user, well below that of current EMI shielding products.

Sealing – Develop a sealing gasket that can sustain 6 bars water tightness and 4 bars gas tightness.

Shielding – Shield for electromagnetic interference by dampening facility of 85 dB in the 100Mhz to 3 Ghz area. This is the main frequency spectra for commercial – non military shielding in 96% of the SME market for EMI shielding.

1.2 Summary of Project Objectives & Major Achievement for Reporting Period 1 and 2

The specific objectives for the project period from 01/09/2005 to 29/02/2008 of the project are summarized in the table below.

Deliverable	Task	Partners Involved	Objective	Achievement During Reporting Period
D1	1.1	Roxtec Fange Pera	Scientific understanding of conductivity in different grades of CNT both multi walled and single walled CNTs.	1. Investigation of the single and multi walled CNT in terms of material price and potential as conductive fillers in polymers. 2. Comparison with other potential filler material. 3. Analyze the potential problems with different fillers and the dispersion. **Task Completed**
D2	1.2	Roxtec Fange Pera Crif	Scientific understanding and of double percolation in PC/PE and EMI shielding properties in CNT enhanced PC/PE.	1. Investigation of the maximum EMI shielding that is possible when using the double percolation technique and compare this with other techniques. 2. Developing a compounding technique for CNT and other fillers. **Task Completed**
D3	1.3	Roxtec Fange Pera Crif	Scientific understanding of extrusion techniques for optimal handling of CNT enhanced polymers to ensure a correct film extrusion technique, In addition the design properties of the EMISHIELD project will be investigated.	1. Develop a method to manufacture test samples. 2. Develop a method to measure the conductivity with varying material composition. 3. Review the proposed gasket design. **Task Completed**
D4	1.4	Roxtec Fange Pionet Teinsa ABB Pera Crif	Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification Plan.	1. Review the results of the scientific studies to plan for maximizing the potential for success of the next stages of the work program. **Task Completed**

D5	2.1	Roxtec Pionet Pera Crif	Investigation of how to improve the gasket design and make the gaskets more users friendly.	1. Investigation of other gasket designs that are used today 2. Investigation of important parameters that can influence the properties of the gasket. 3. Develop a new gasket design that is more user friendly and that fulfill our technical requirements. **Task Completed**
D6	2.2	Roxtec Bekina Pera Crif	Study the properties of the selected materials.	1. Compare different material that can be incorporated in the new design. 2. Investigate the properties of the material so that it fulfills the mechanical, fire resistance and the conductivity requirements. **Task Completed**
D7	2.3	Roxtec Bekina Pera Crif	Investigate and estimate the necessary changes in the production and the costs to realize the new gaskets.	1. Estimation of the production and material costs of the new type of gasket. 2. Investigation of the changes that will be necessary in the production. **Task Completed**
D8	2.4	Roxtec Bekina Pionet Pera Crif	Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification plan.	1. Review the results of the scientific studies to plan for maximizing the potential for success of the next stages of the work program. **Task Completed**
D9	**2.5**	Roxtec Pionet Teinsa	Mid term dissemination plan including contact to potential 20 end users for early market stimulation. Participation in two relevant trade fairs to contact new distributors. Update of website presenting the first technological results in the development work	1. Promotion of the project to grow market interest for the EMISHIELD product. 2. Identification other possible applications. **Task Completed**
D10	**3.2**	Bekina	Production of samples that will be used to measure the properties of the material.	Based of the compounding investigations performed (D9), shielding tests were performed on the following compound combinaision: standard Ghislaved layer + 3 % CNT Nanocyl + flameretardent ATH.

				Matrixes have been defined to make plates (2mm thickness) in order to test the EMI property of the different compound combination. **Task Completed**
D12	**4.1**	Roxtec	Design and fabrication of prototype for the EMISHIELD gasket	Design and fabrication of prototypes has been made throughout the project. Until today's date the design has been verified a couple of times and new design proposals coming up to achieve an overall combination of the different aspects to take into consideration in such a complex project. The trials have been showing promising results, and further step is taken to achieve the final design of a new EMC product range. **Task Completed**
D14	**4.3**	Roxtec	Successful demonstrations to the project partners of the case study prototypes. Validation of the commercial viability of the technology application, including feature benefits and cost implications, by representatives of the primary target market sector.	During the meetings it has been discussed and evaluated by the partners any possible design proposals and by this giving the immediate response on the design itself, and also with respect to the above mentioned parts. As price, production cost and installation time and maintenance cost. When designs have been worth looking further on, prototypes have been made. These have been presented to carefully select strategic customers in the field as well as the internal sales force with subsidiaries and distributors. The proposed designs have been well accepted by the informed people. **Task Completed**
D11-D15	**3.3-4.4**	Pera	Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification Plan	The problematic was the processing of the EPDM with compounding availability with CNT. As showed in the pictures below, the CNT percentage could influence a lot the processing and quality (tightness and hardness) of the rubber produced. The first mitigation action was to set up a test matrix to determine the optimum percentage of CNT to use. The second mitigation action was to introduce TPE material instead of EPDM. **Task Completed**
D16	**5.1**	Roxtec	A report on potentially competitive patents and a plan for patent application(s) if required with exploitation agreements between the partners.	To get a clear picture we have asked the Patent attorneys Ström & Gullikson to perform an investigation for possible conflict with other patents and to see which possibilities we have for application

				for patents at this stage. They have been asked to make a search for elastomer material for electromagnetic shielding. The search has been done for European, German, English and international patent applications and patents. **Task Completed**
D18	**5.3**	Fange	2 papers presented at 3 conferences and 3 major exhibitions with at least between 50 and 2000 attendees respectively and production of 2 publications in the form of editorials, technical papers and industry press	A paper was writen and submitted for for the 6th International conference on Materials processing for properties and performance in China arrranhed by the Symposium on Nanomaterials and nanostructures.
D20	**5.5**	Teinsa	150 companies contacted directly to promote the project results. 40 companies stimulated to apply or use the results in their future product strategy. 25 companies engaged in detailed knowledge or technology transfer, 3 years post project completion. 5 European companies facilitated to adopt the results in the generation of new products or services, 3 years post project completion.	A advertisement brochure has been created to promoted the Emishield results for 154 company. A mailing list created by SIRRIS will be used where more than 2000 members subscribed (http://techniline.sirris.be/). **Task Completed**
D21	**6.1**	Roxtec	Delivery of dissemination and use plan (DUP) – Final version	Roxtec created a dissemination plan **Task Completed**
D32		Roxtec	Design and building of public website for dissemination of results and market stimulation. In addition a publishable extended summary of the final report will be added	Roxtec created a web site to promote the project results **Task Completed**

1.3 Changes During First Reporting Period

Changes to Work Program

Prior to the 3-months meeting, it was seen that the initially proposed film concept wouldn't improve the gasket and was difficult to incorporate in the design. Moreover it was seen that the properties of the material was not sufficient to reach desired EMI shielding performances.

The consortium discussed different approaches and it was decided that EPDM rubber would be used as gasket matrix material. The consortium found it necessary to perform a few adjustments in the work description. The review will affect work package 1, 2 and 3, which cover the scientific studies and the development of the composite material.

Partners and Budget changes

Bekina have been invited into the Consortium by the members in order to replace DKI which wanted to be removed from the project. DKI's budget has been reassigned to Bekina; the overall figures have remained the same.

ABB Power Technologies AB withdraws from the EMISHIELD project. In the last few months the ABB Power Technologies AB business has gone through a major re-structure, including staff changes and strategy changes to our manufacturing process. Therefore, ABB Power Technologies AB could not provide to the project the requested efforts.

General comment

The project start date was 01/09/2005, however in order to ensure that all partners could attend the kick off meeting this was delayed until 06/10/2005.

Furthermore, we have been delayed due to difficulties finding an external partner that could make the necessary EMI shielding measurements. These measurements are a critical for the project. An external partner was found and during the summer we were in the negotiation phase. A contract was established in the end of the summer and the first tests were carried out in October. We are still waiting to get the complete report from the tests, but have seen the first results and they look very promising. We will now be able to catch up with the time and be able to follow initial schedule.

It was seen during the work in WP2 that more information about the final gasket material was needed before the final adjustments to the design could be made. Therefore some of the work in WP 2 has been postponed, and the work in WP3 has started at an earlier stage. This has not caused any delays in the project as a whole but caused some investigations to start earlier and other to start a little bit later than planned according to the Annex 1.

The initial person responsible for Roxtec, Joakim Hellkvist left the company (June 2007) and has been replaced by Ulf Hildingsson. As a consequence, the project was delayed for almost two months.

section 2 – WORK PACKAGE PROGRESS REVIEW FOR REPORTING PERIOD 1

2.1 Work Package Objectives

The specific work package objectives for the project duration of 01/09/2005 to 29/02/2008 of the project are summarised in the table below.

Work-package No	Work package title	Lead contractor Short Name	Person-months	Start month	End month	Deliverable No
1	Scientific study of EMI shielding using CNT as conductive filler.	Pera	10.90	1	7	D1-D4
2	Study of improved gasket design	Crif	10.4	5	12	D5-D8
3	Investigation of the effect off different fillers in Ethylene Polypylene Diene (EPDM) rubber	Bekina	11.5	9	15	D9-D11
4	Integration of EMI shielding gasket and Industrial Trials	Teinsa	16.7	13	23	D12-15
5	Innovation Related Activities	Roxtec	11.55	1	24	D16-D20
6	Consortium Management	Roxtec	1.85	1	24	D21-D30
7	Project Management	Roxtec	3.6	1	24	D31-D36

2.2 Overview of Work Package Technical Progress

Work Package 1 – Scientific study of EMI shielding using CNT as conductive filler.

Task 1.1: Scientific understanding of conductivity in different grades of CNT used as filler in polymer

Task Leader: Pera

Partners Involved: Roxtec, Fange, Pera

Objectives: To quantify the theoretical limits of utilization of CNT as EMI shielding material.

Progress: Literature research has been carried out to gain knowledge about single and multi walled nanotubes. The theoretical conductivity of CNT has been estimated and comparison with other fillers has been done to ensure that right technique is chosen. The material prices have been investigated and different manufacturer have been compared to find the best offers. The possibility to estimate the EMI shielding properties of the gaskets by conductivity has been investigated.

Task 1.2: Scientific study on Double CNT Percolation in PC/PE

Task Leader: Pera

Partners Involved: Roxtec, Fange, Pera, Crif

Objectives: Acquire scientific understanding of double CNT percolation PC/PE polymers as well as an enhanced understanding of the mechanism behind the different stages of the CNT filler threshold in different polymer types using different mixing methods and polymer grades.

Progress: The possibility to use the double percolation technique to manufacture gaskets has been investigated. The maximum EMI shielding has been estimated, and compared with other composite solutions. The properties of the polymer matrix material have been investigated and compared with other possible matrix materials to ensure that the best solution is chosen.

Task 1.3: Scientific study of CNT dispersion with polymers, additives and fillers

Task Leader: Pera

Partners Involved: Roxtec, Fange, Pera, Crif

Objectives: To enhance the scientific understanding of double percolation of CNT in PC/PE

Progress: A compounding technique for CNTs and other fillers has been developed for initial trials.

Task 1.4: Review and Risk Assessment

Task Leader: Crif

Partners Involved: Roxtec, Fange, Pionet, Teinsa, ABB, Pera, Crif

Objectives: Review the results of the scientific studies to plan for maximizing the potential for success of the next stages of the work program.

Progress: A document has been created that summarizes the problems and risks that have been seen in the project relative to the new orientation.

Work Package 2 – Study of improved gasket design

Task 2.1: Investigation of how to improve the gasket design and make it more users friendly.

Task Leader: Pera

Partners Involved: Roxtec, Pionet, Pera, Crif

Objectives: Investigation of how to improve and simplify the gasket design.

Progress: Different design proposals have been developed and simple prototypes built. The potential of the design proposals have been investigated and evaluated.

Task 2.2: Study the properties of the selected materials

Task Leader: Bekina

Partners Involved: Roxtec, Bekina, Pera, Crif

Objectives: Study the properties of the selected materials.

Progress: Investigation to find suitable gasket material and suppliers. The properties of the material that was proposed in task 2.1 has been investigated.

Task 2.3: Investigate and estimate the necessary changes in the production and the costs to realize the new gasket

Task Leader Roxtec

Partners Involved: Roxtec, Bekina, Pera, Crif

Objectives: Investigate and estimate the necessary changes in the production and the costs to realize the new gasket.

Progress: Results from tasks 2.1 and 2.2 will be used to estimate the necessary changes in the production and the new production costs.

Task 2.4: Review and Risk Assessment

Task Leader: Crif

Partners Involved: Roxtec, Bekina, Pionet, Pera, Crif

Objectives: Review the results of the scientific studies to plan for maximizing the potential for success of the next stages of the work program.

Progress: A document has been created that summarizes the problems and risks that have been seen in the project.

Task 2.5: Mid Term Dissimination plan for early market stimulation

Task Leader: Roxtec

Partners Involved: Roxtec, Pionet, Teinsa

Objectives: To create spin-offs from the participant organizations and promote the broad application of the results by organizations outside the consortium.

Progress: Identification of other possible applications of the process developed and product markets with attention to packaging for electronical devices.

Work Package 3 – Investigation of the effect of different fillers in Ethylene Propylene Diene (EPDM) rubber

Task 3.1: Development of procedure to enable compounding of fillers and EPDM.

Task Leader: Pera

Partners Involved: Roxtec, Bekina, Fange, Pera, Crif

Objectives: Development of procedure to enable compounding of fillers and EPDM. Investigate the mechanical and electrical properties of the manufactured material.

Progress: The incorporation of conductive fillers like Carbon Nanotubes (CNT) into the EPDM matrix has been successfully performed by using a twin screw extruder (normally dedicated to the compounding of thermoplastic materials) but several adaptations to the usual process have been therefore required. It was among other needed to maintain all the process at a very low temperature (< 50°C) and to work with low rotational speed of the screws to avoid internal plasticizing. Nevertheless it was possible to perform a good compounding of the material.

Task 3.2: Production of samples

Task Leader: Bekina

Partners Involved: Roxtec, Fange, Pionet, Pera, Crif, Bekina

Objectives: Production of samples that will be used to test the mechanical and conductive properties of the composites. The electrical measurements will be used for rapid discrimination between potential compounds. The mechanical measurements will be used to confirm that the fillers don't affect the flexibility of the material too much.

Progress: Based of the compounding investigations performed (D9), shielding tests were performed on the following compound combination: standard Ghislaved layer + 3 % CNT Nanocyl + flameretardent ATH. Matrixes have been defined to make plates (2mm thickness) in order to test the EMI property of the different compound combination.

Task 3.3: Review and Risk Assessment

Task Leader: Crif

Partners Involved: Roxtec, Fange, Pera, Crif, Bekina

Objectives: Review the results of the scientific studies to plan for maximizing the potential for success of the next stages of the work program.

Progress: Create a document that summarizes the problems and risks that have been seen in the project.

Work Package 4 – Integration and Industrial Trials

Task 4.1 Design and fabrication of prototype for the EMISHIELD gasket and EMC control system

Task Leader: Teinsa

Partners Involved: Roxtec, Bekina, Pionet, Pera, CRIF

Objectives: To carry out industrial trials on the resultant EMISHIELD system to establish its efficiency and develop final cost model

Progress: Design and fabrication of prototypes has been made throughout the project. Until today's date the design has been verified a couple of times and new design proposals coming up to achieve an overall combination of the different aspects to take into consideration in such a complex project. The trials have been showing promising results, and further step is taken to achieve the final design of a new EMC product range.

Task 4.2 Industrial Validation of Technical Capability

Task Leader: Teinsa

Partners Involved: Roxtec, Fange, Bekina, Pionet, Pera, CRIF

Objectives: To validate that the technology created is capable of reaching manufacturing performance to meet the specifications and cost models of the primary target sector. To validate that the components are suitable for their designated application that achieves EMI shielding.

Progress: a validation protocol has been create and followed to test the different samples.

Task 4.3 Demonstration of Prototypes

Task Leader: Teinsa

Partners Involved: Roxtec, Fange, Bekina, Pionet

Objectives: Successful demonstrations to the project partners of the case study prototypes. Validation of the commercial viability of the technology application, including feature benefits and cost implications, by representatives of the primary target market sector.

Progress: During the meetings it has been discussed and evaluated by the partners any possible design proposals and by this giving the immediate response on the design itself, and also with respect to the above mentioned parts. As price, production cost and installation time and maintenance cost.

When designs have been worth looking further on, prototypes have been made. These have been presented to carefully select strategic customers in the field as well as the internal sales force with subsidiaries and distributors.

The proposed designs have been well accepted by the informed people.

Task 4.4 Review and Risk Assessment

Task Leader: Teinsa

Partners Involved: Roxtec, Bekina, Fange, Pionet, Teinsa, Pera, CRIF

Objectives: Review the results of the scientific studies to plan for maximising the potential for success of the next stages of the work programme.

Progress: Create a document that summarizes the problems and risks that have been seen in the project.

2.3 Deviation from the Plan and Corrective Actions

Work-package No	Title	Deviation from Plan	Corrective Action
WP1	Tasks: 1.2, 1.3	It was seen during the investigation that the initially proposed polymer didn't have the desired properties for this application.	It was decided that the material should be changed. EPDM was found to be a suitable material for this application and therefore emphasis was put on incorporating the fillers in EPDM rubber instead of PC/PE.
WP2	Tasks: 2.1, 2.2, 2.3, 2.4, 2.5	It was seen that the design needed improvements to enable grounding of the cables.	The work package was changed and emphasis was put on improvement of the design.
WP3	Tasks: 3.1, 3.2	Larger focus was needed on the development of the new material.	The work package was changed and emphasis was put on development of the new material.

2.4 Work Package Deliverables Update

Del. No	Deliverable name	Delivery date	% Complete
D1	**Task 1.1** Scientific understanding of conductivity in different grades of CNT both multi walled and single walled CNTs.	Month 5	100
D2	**Task 1.2** Scientific understanding and of double percolation in PC/PE and EMI shielding properties in CNT enhanced PC/PE.	Month 7	100
D3	**Task 1.3** Scientific understanding of extrusion techniques for optimal handling of CNT enhanced polymers to ensure a correct film extrusion technique, In addition the design properties of the EMISHIELD project will be investigated.	Month 7	100
D4	**Task 1.4** Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification Plan.	Month 7	100
D5	**Task 2.1** Investigation of how to improve the gasket design and make the gaskets more users friendly.	Month 12	100
D6	**Task 2.2** Study the properties of the selected materials.	Month 12	100
D7	**Task 2.3** Investigate and estimate the necessary changes in the production and the costs to realize the new gaskets.	Month 12	100
D8	**Task 2.4** Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification plan	Month 12	100
D9	**Task 2.5** Mid term dissemination plan including contact to potential 20 end users for early market stimulation. Participation in two relevant trade fairs to contact new distributors. Update of website presenting the first technological results in the development work	Month 12	100
D9	**Task 3.1** Development of procedure to enable compounding of fillers and EPDM.	Month 15	100
D10	**Task 3.2** Production of samples that will be used to measure the properties of the material.	Month 15	100
D11	**Task 3.3** Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification Plan.	Month 15	100
D12	**Task 4.1** Design and fabrication of prototype for the EMISHIELD gasket	Month 26	100
D13	**Task 4.2** System costing and installation test to measure the new efficiency compared to other systems for EMI shielding	Month 28	100
D14	**Task 4.3** Successful demonstrations to the project partners of the case study prototypes. Validation of the commercial viability of the technology application, including feature benefits and cost implications, by representatives of the primary target market sector.	Month 29	100
D15	**Task 4.4** Feasibility and technological risk review meeting, Risk assessment report, Standards conformity report, Modification Plan	Month 29	100
D16	**Task 5.1** A report on potentially competitive patents and a plan for patent application(s) if required with exploitation agreements between the partners.	Month 30	100
D17	**Task 5.2** Production of support material for transfer of the knowledge to the partners through case studies and a generic design guide.	Month 30	100
D18	**Task 5.3:** 2 papers presented at 3 conferences and 3 major exhibitions with at least between 50 and 2000 attendees respectively and production of 2 publications in the form of editorials, technical papers and industry press	Month 30	100

D19	**Task 5.4** A report on the standards, ethical and regulatory aspects of the exploitation of the results	Month 30	100
D20	**Task 5.5** 150 companies contacted directly to promote the project results. 40 companies stimulated to apply or use the results in their future product strategy. 25 companies engaged in detailed knowledge or technology transfer, 3 years post project completion. 5 European companies facilitated to adopt the results in the generation of new products or services, 3 years post project completion.	Month 30	100
D21	**Task 6.1:** Delivery of dissemination and use plan (DUP) – Final version	Month 30	100
D22	**Task 6.2:** Delivery of six months progress reports; draft and final plan for using and disseminating knowledge (D22, D25), mid-term and final activity report (D23, D26), mid-term and final management report (D24, D27). Submission of the cost statements at mid-term and end of project. Organise kick-off, mid-term and final meetings.	Month 30	100
D23	**Task 6.3:** Provision of audit certificates and bank guarantees and amended consortium agreement	Month 30	100
D24	**Task 6.4:** Report on gender, societal and ethical issues of exploitation	Month 30	100
D25	Draft of the Plan for using and disseminating knowledge	Month 12	100
D26	Mid-term activity report	Month 12	100
D27	Mid-term management report	Month 12	100
D28	Final plan for using and disseminating knowledge	Month 30	100
D29	Final activity report	Month 30	100
D30	Final management report	Month 30	100
D31	Public version of final report	Month 30	100
D32	Design and building of public website for dissemination of results and market stimulation. In addition a publishable extended summary of the final report will be added	Month 30	100
D33	**Task 7.1** Continuous review and management of project progress to ensure rigorous compliance against scientific and technological objectives	Month 30	100
D34	**Task 7.2** Continuous review and management of project impact on economic and societal issues	Month 30	100
D35	**Task 7.3** Continuous workflow scheduling and Work Plan change control procedures to ensure effective workflow throughout project	Month 30	100
D36	**Task 7.4** Ensuring continuous communication between partners within work packages	Month 30	100
D37	**Task 7.5** Provision of minutes taken at project management meetings	Month 30	100
D38	**Task 7.6** Co-ordination of technical activities between partners within each work package	Month 30	100

In progress

Completed

Section 3 – CONSORTIUM MANAGEMENT

3.1 Consortium Management Tasks & Achievement

There have been five project review meetings since the start of the project. These have all combined technical, management and exploitation topics.

All meetings have been characterized by good attendances and open discussion, thus exploring broad views on the direction and content of the technical work. Partners have also carried out technical presentations at these meetings and have brought technical knowledge to the project consortium. This clearly illustrates the positive commitment of the partners

Between the main technical and management meetings some individual company meetings have been held to discuss specific project issues to focus the work program.

The order of several tasks has been amended in order to accumulate specific knowledge. This was achieved by starting some tasks early and bringing work forward.

The venues for all technical meetings have been rotated at different partner-sites to give the consortium an opportunity to learn more about how the host partner operates. A tour of the facilities has always followed the meetings.

The time schedule has partly been altered due to the delayed kick off, and problems finding equipment and finding external partners for EMI measurements. These things have now been sorted out and to catch up with some work tasks 3.1 and 3.2 has started earlier.

Consortium Status Overview

The consortium is working well together; it has been a well balance group with each member offering its own unique knowledge. During the project Bekina has joined the consortium and replaced DKI which has further strengthen the project.

Project Management Structure

The project is controlled by a Technical Board, which in turn is headed by the coordinator (Ulf Hildingsson), who has the ultimate responsibility for the project, and acts as Chairman. Each task is allocated to the proposer or RTD performer with the most appropriate skills or requirements relating to that particular task. They are responsible for delivery of that task to plan. The task leaders are listed in the work program and they report to the coordinator. A consortium agreement has been prepared and signed to cover any specific issues that are not covered in the EC contracts, this details voting and dispute issues. Partnership voting are undertaken on the basis of one vote per partner (excluding the RTD performers), with a majority of 1 needed. IT based management and communication techniques are used within this research program. Should any confidentiality issues arise between parties then they will be submitted to the Project Manager for mediation and resolution. Prior to meetings, information is circulated to all partners in advance to enable maximum time usage.

3.3 Project Timetable & Status

3.3.1 Work Program Original

#	TASK	WP/Task Leader	MONTHS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.0	**Scientific study of EMI shielding using CNT as filler**	**Pera**																								
1.1	Scientific study of conductivity in CNT	Pera																								
1.2	Scientific study of double percolation in PC/PE	Pera																								
1.3	Scientific understanding near filed measurement techniques and software requirements	Pera																								
1.4	Review and Risk Assessment	CRIF																								
2.0	**Study of improved gasket design**	Crif																								
2.1	Investigation of how to improve the gasket design and make it more user friendly	Pera																								
2.2	Study the properties of the selected materials.	Bekina																								
2.3	Investigate and estimate the necessary changes in the production and the costs to realize the new gasket	Roxtec																								
2.4	Review and Risk Assessment	CRIF																								
2.5	Mid-Term dissemination plan	Roxtec																								
3.0	**Investigation of the effect of different fillers in Ethylene Propylene Diene (EPDM) rubber**	Bekina																								
3.1	Development of procedure to enable compounding of fillers and EPDM.	Pera																								
3.2	Production of samples.	Bekina																								
3.3	Review and Risk Assessment	CRIF																								
4.0	**Integration & Industrial Trials**	**Teinsa**																								
4.1	Integration of system components & development of prototypes	Roxtec																								
4.2	Establish efficiency of integrated system and system cost	Teinsa																								
4.3	Demonstration of Prototypes	Roxtec																								
4.4	Review and Risk Assessment	Pera																								
5.0	**Innovation Related Activities**	**Roxtec**																								
5.1	Protection of IPR	Roxtec																								
5.2	Absorption of results by proposes	Pera																								
5.3	Dissemination of knowledge	Fange																								
5.4	Socio-economic aspects	ABB																								
5.5	Development of the Exploitation Strategy	Teinsa																								
6.0	**Consortium Management**	Roxtec																								
6.1	Co-ordination of Knowledge Management and Innovation Related Activities	Roxtec																								

6.2	Co-ordination of Reporting and Communication Activities at a Consortium Level	Roxtec	
6.3	Co-ordination of Legal and Financial Aspects	Roxtec	
6.4	Co-ordination of the Gender Equality, Ethical and Society Aspects	Roxtec	
7.0	**Project Management**	**Roxtec**	
7.1	Review and management of project progress against scientific and technological objectives	Roxtec	
7.2	Reviews and management of impact on economic and societal issues	ABB	
7.3	Workflow scheduling and Work Plan change control procedure	Fange	
7.4	Communication between partners within the work package	Teisna	
7.5	Provision of the minutes taken at these meetings	Pionet	
7.6	Co-ordination of technical activities between partners within work packages	Bekina	

3.3.2 Work Programme As Updated

#	TASK	WP/Task Leader	MONTHS 1	2	3	4	5	**6**	7	8	9	10	11	**12**	13	14	15	16	17	**18**	19	20	21	22	23	24	25	26	27	28	29	**30**
1.0	**Scientific study of EMI shielding using CNT as filler**	**Pera**																														
1.1	Scientific study of conductivity in CNT	Pera																														
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7.6	Co-ordination of technical activities between partners within work packages	Bekina																																

3.3.3 Meeting & Communication

There have been twelve project review meetings since the start of the project. These have all combined technical, management and exploitation topics.

Project Review Meetings

	Date	Type of meeting	Location
1	06.10.2005	Kick-off	Pera
2	31.01.2006	Month 3 Technical	Roxtec
3	10.05.2006	Month 6 Management/Technical	Crif
4	20.09.2006	Month 9 Technical	Bekina
5	08.11.2006	Month 12 Management/Technical	Pera Denmark
7	25.1.2007	Month 15 Technical	KHBO Oostende, Belgium
8	18.04.2007	Month 18 Management/Technical	Roxtec, Karlskrona, Sweden
9	12.07.2007	Month 21 Technical	Pera Denmark, Copenhagen, Denmark
10	18.10.2007	Month 24 Management/Technical	Bekina, Kluisbergen, Belgium
11	17.01.2008	Month 27 Technical	CRIF, Belgium
12	20.02.2008	Month 30 Management/Technical	Roxtec, Karlskrona, Sweden

There have been very many constructive technical and management meeting discussions and the partners are working well together. This can be seen in the minutes and the regular communication that has taken place between the partners.

In addition to the formal meetings a number of working party and internal meetings have taken place to discuss the technical aspects of the project.

Project Work Party Meetings

	Date	Type of Meeting	Location
1	10.01.2005	Technical/Management	Roxtec
2	27.01.2006	Technical	Pera UK
3	24.03.2006	Technical/Management	Bekina
4	09.05.2006	Technical, Bekina and Roxtec	Bekina
5	13.06.2006	Technical, Bekina and Roxtec	Roxtec
6	04.10.2006	Technical/Management Teinsa and Pera	Pera
7	11.10.2006	Technical/Management Teinsa and ABB	ABB

Section 4 – OTHER INFORMATION

4.1 SME Benefits of the RTD Performers Work

The direct benefit shared within the partnership relates to the companies forming the supply chain for the proposed technology to help license and proliferate it as widely as possible across the European Union and North American markets. The consortium partners will benefit from the direct sale of the integrated product, and the license and royalty revenues from manufacturing and distribution worldwide.

The innovative differentiation that this technology will give to each of the partners with respect to their competitors is such that each partner will be able to capture new market share within their existing domains, attack previously untapped markets and leverage opportunities that would otherwise be denied them. Specifically, Roxtec (1) will use the developed technology to leverage its position as a supplier of high-value equipment to electronic device sector, Bekina (9) will through the supply of very advanced CNT compounds combat competition from Asian compounders, Fange (3) will actively pursue new sales channels for their machining technology, based on this new application and market for their EMC systems, Pionet (4) will pursue new sales for their EMI shielding services, based on this new application and market for their systems, Teinsa (5) will use the developed technology to new sales channels for its line of EMC systems.

Finally, the large enterprise ABB Power Technologies (6) will use the integrated system to help them combat competition from American service provider, together with their market brand as a primary energy engineering company to act as one of the initial customers and promoter of the EMISHIELD product on behalf of the SME partners. ABB's role in the partnership will provide significant market credibility amongst EMI shielding customers through the strong and multinational ABB brand. The consortium agreement does not assign any of the resulting IPR to ABB. However, we see ABB as a unique source for providing valuable market knowledge and early end-user feedback in addition to promote the EMISHIELD product on behalf of the SME partners.

4.2 Principal Benefits

Exposure to new and emerging technologies and innovation and the opportunity to participate in dissemination and associated exposure at trade fairs in conjunction with the RTD organisations.

4.3 Secondary and Emerging Benefits

The technology initially developed for Roxtec's EMI shielding gaskets, will also benefit other sectors where EMI shielding rubbers could be used.

4.4 Overall Contribution of Consortium

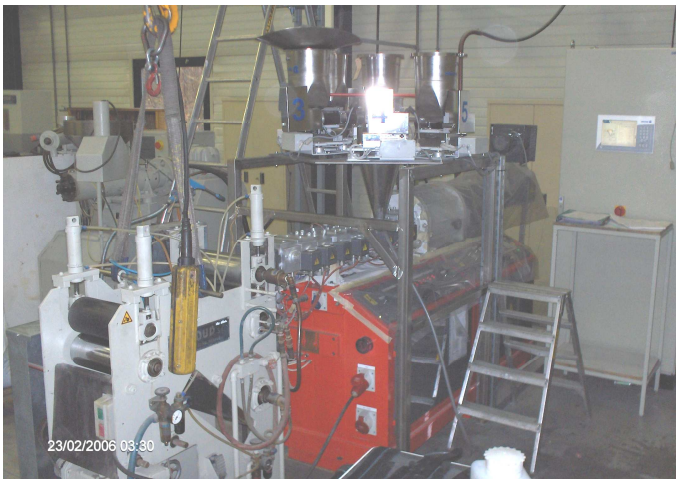
The SME's have made valuable and real contribution to the project so far, in line with the project plan. Both RTD performers have made valuable contributions to the project, and

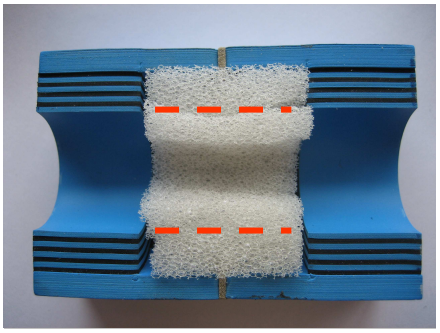
have worked in close conjunction with each other and with the whole Consortium. The work have been equally balance between SME's and RTD performers, with the RTDs providing the scientific knowledge background and research expertise, and the SMEs providing in-depth knowledge of the market and technologies.

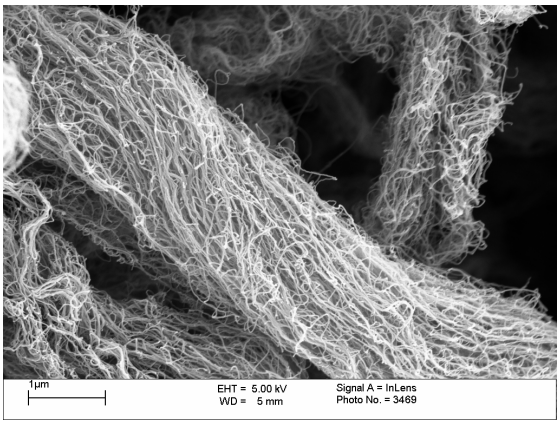
4.5 Dissemination

A final plan for using and disseminating knowledge has been created.

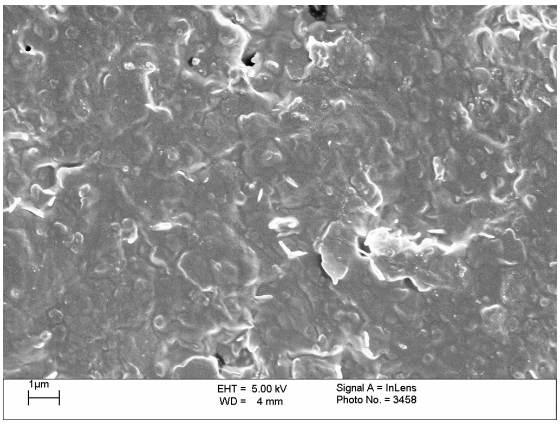
4.6 Project Images



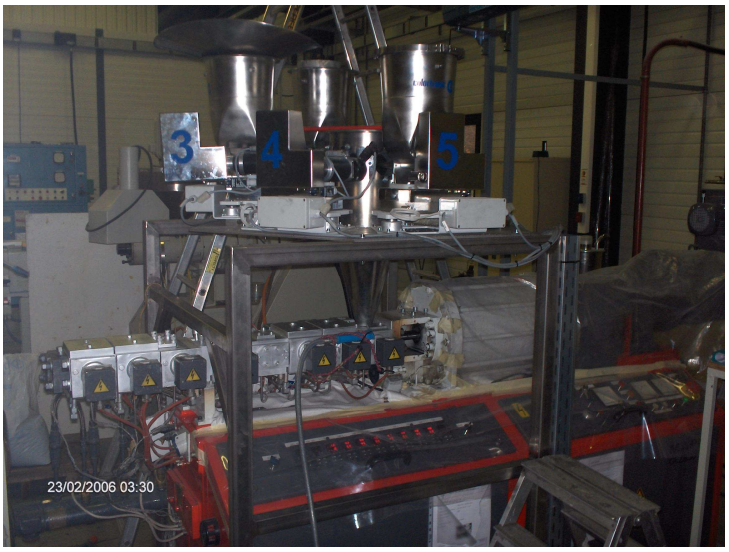




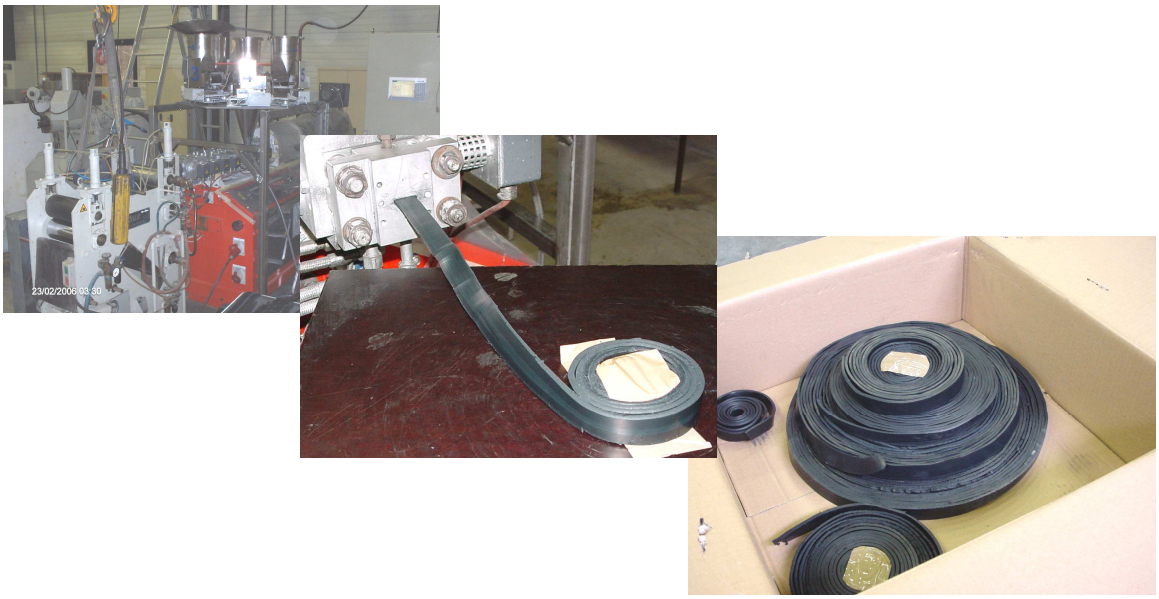
Carbon nanotubes

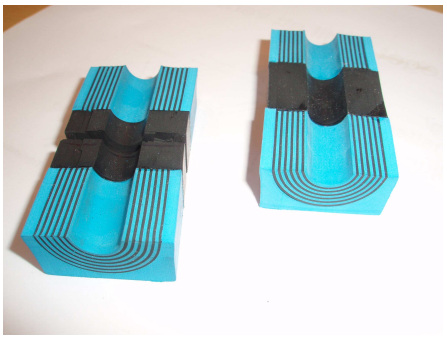


Caron nanotube composite

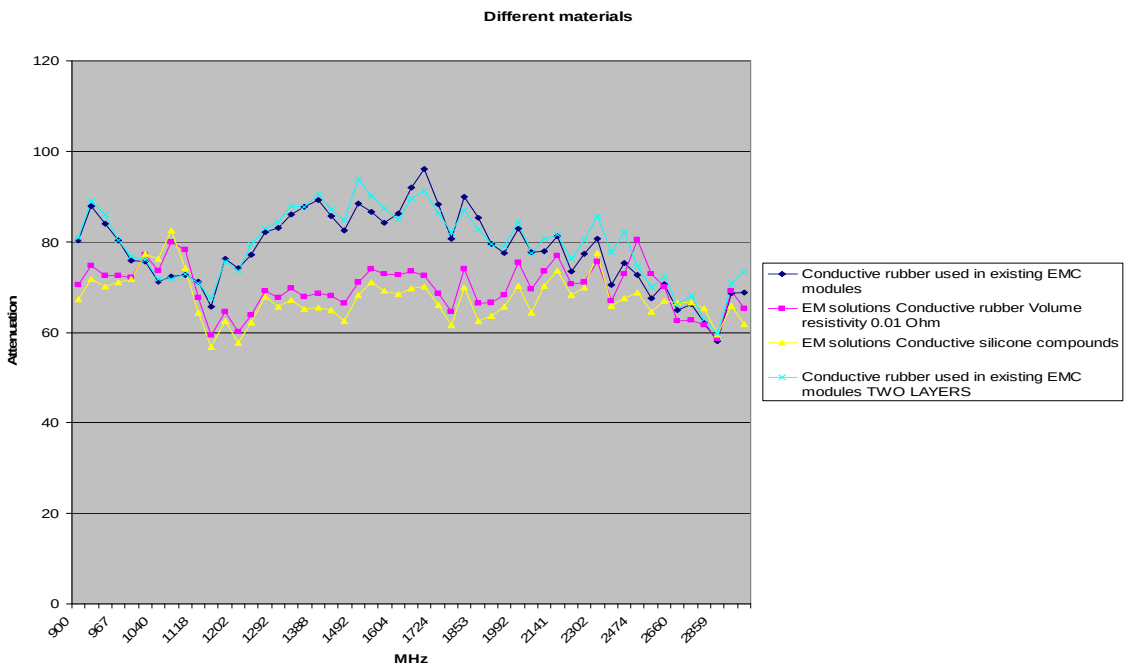


Compounding by CRIF/PERA (EPDM) –
Modules processing by BEKINA (compression) –
(EMI characterization by ROXTEC)

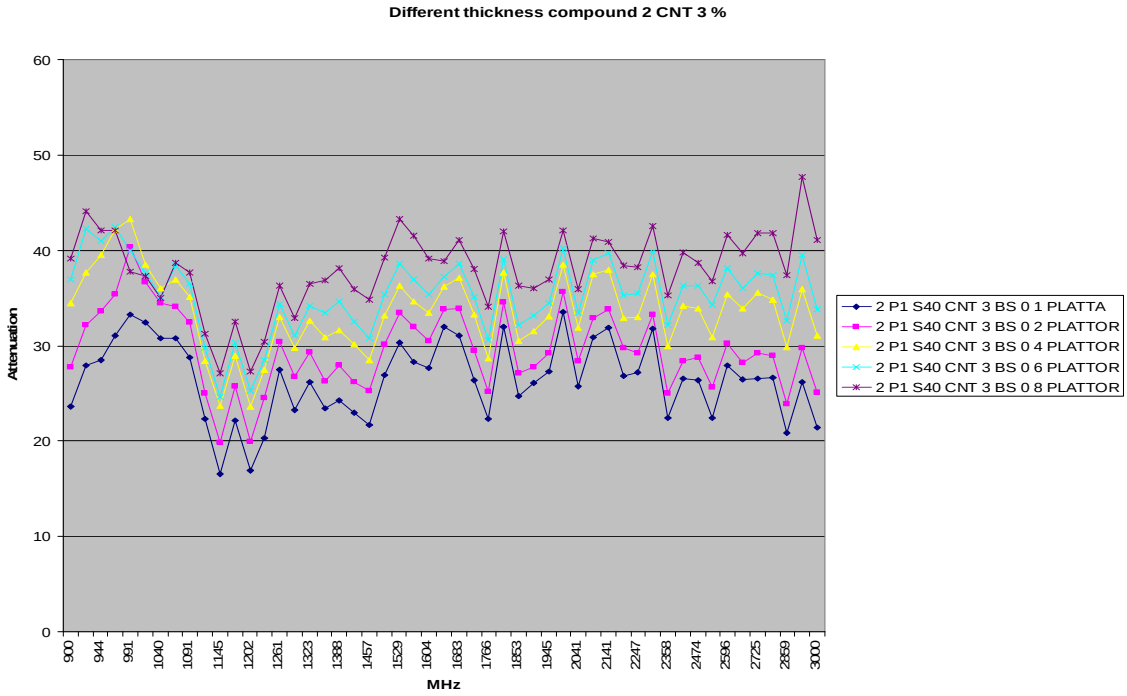




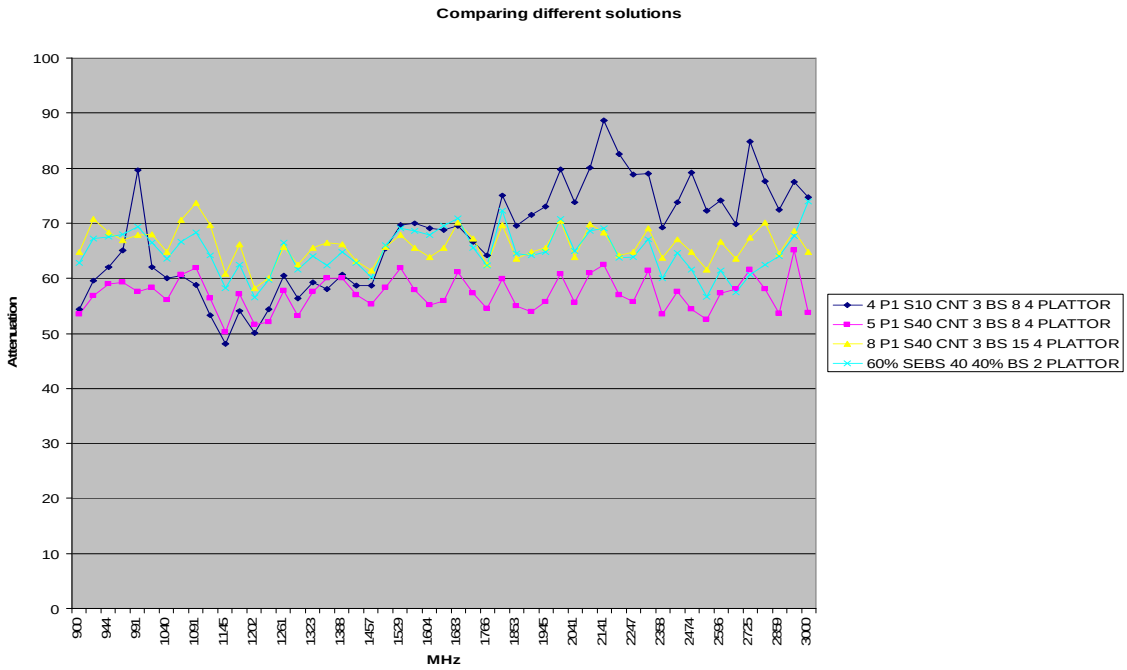
Prototype modules



Different materials



Different thickness compound



Comparing different solutions

4.7 Conclusion

- For compound nr 2 we can see a linear function of adding thickness
- For the other compounds a risk is that we have reached the maximum possible measurement level at the lab, (around 70 dB).
- We cannot determine the real attenuation without measuring at a better lab
- This means that we do not know how the function looks like for the compound nr 4, 5 and 8 when adding up the thickness with more plates.
- The compounds 4,5,8 and the TPE with a concentration of 60%SEBS 40 + 40 % BS 2 plates needs to be evaluated further with respect to price and performance