

**Project No.: 147426**  
**Project acronym: TANOCOMP**

**Project title:**  
**Training on the nANOTEchnology aspects of plastic COMPosites with  
enhanced properties for use in high-strength applications**

**R17 - ACCREDITATION TOOL**

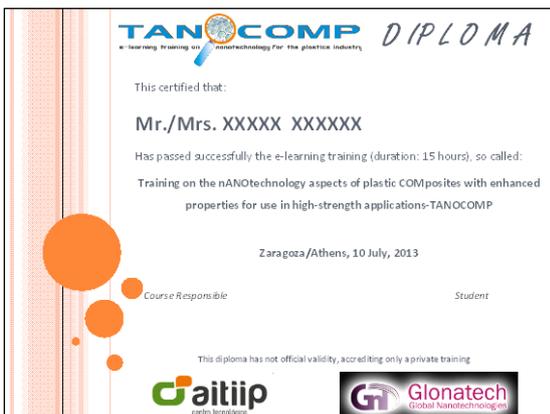
## INTRODUCTION

**TANOCOMP project** is the result of two years of intensive work of a consortium formed by four partners from four different countries. These partners consolidated the idea of the development of a new e-Learning methodology in order to boost and wide their knowledge on nanotechnology and carbon nanotubes as a reinforcement material on plastic matrices.

TANOCOMP project was aimed to develop an e-Learning training for the identified needs of plastics producers and plastics processors who are interested in on-the-job training in the use of nanotechnology in plastics. TANOCOMP e-Learning will give you a theoretical overview on the incorporation of Carbon Nanotubes (CNTs) in thermoplastics.

The TANOCOMP consortium devised the creation of an certificate to deliver to those end-users which pass the course. This certificate is called "Accreditation Tool" and it is shown below:

Diploma (English):

<p style="text-align: center;"><b>CONTENTS</b></p> <p><b>Unit I: Basics</b></p> <ul style="list-style-type: none"> <li>○ Introduction to Nanotechnology</li> <li>○ Overview of thermoplastic materials</li> <li>○ Introduction to extrusion / injection moulding process</li> </ul> <p><b>Unit II: Carbon Nanotubes (CNTs) and their use in the plastics sector</b></p> <ul style="list-style-type: none"> <li>○ Carbon nanotube production methods</li> <li>○ Properties of carbon nanotubes and their derivatives</li> <li>○ Commercial applications</li> <li>○ Use of carbon nanotubes in composites</li> </ul> <p><b>Unit III: Extrusion &amp; Injection Moulding and incorporation of CNTs</b></p> <ul style="list-style-type: none"> <li>○ CNT Masterbatches             <ul style="list-style-type: none"> <li>• Different compounds</li> <li>• Benefits / costs</li> </ul> </li> <li>○ Parameters definition</li> <li>○ Problems and solutions of processing CNT composites</li> <li>○ Challenges and future applications of CNT based materials</li> </ul> <p><b>Unit IV: Carbon nanotubes: Safety, health and environmental issues</b></p> <ul style="list-style-type: none"> <li>○ Toxicological and eco-toxicity data</li> <li>○ Handling during synthesis and product development</li> <li>○ Awareness and good practice in CNT handling</li> <li>○ Overview of national and European regulations</li> </ul>	 <p style="text-align: center;"><b>TANOCOMP DIPLOMA</b></p> <p style="text-align: center;">This certified that:</p> <p style="text-align: center;"><b>Mr./Mrs. XXXXX XXXXXX</b></p> <p style="text-align: center;">Has passed successfully the e-learning training (duration: 15 hours), so called:</p> <p style="text-align: center;">Training on the nANotechnology aspects of plastic COMposites with enhanced properties for use in high-strength applications-TANOCOMP</p> <p style="text-align: center;">Zaragoza/Athens, 10 July, 2013</p> <p style="text-align: center;">Course Responsible _____ Student _____</p> <p style="text-align: center;"><small>This diploma has not official validity, accrediting only a private training</small></p> <p style="text-align: center;"> </p>
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Diploma (Spanish):

 <p style="text-align: center;"><b>TANOCOMP DIPLOMA</b></p> <p style="text-align: center;">El alumno/a</p> <p style="text-align: center;"><b>D/ª, XXXXX XXXXXX con D.N.I XXXXXXXXXX</b></p> <p style="text-align: center;">ha cursado con aprovechamiento la acción formativa en la modalidad e-learning de 15 horas de duración, con denominación:</p> <p style="text-align: center;"><b>Capacitación sobre los aspectos de la nanotecnología en compuestos plásticos con propiedades mejoradas para uso en aplicaciones de alta resistencia-TANOCOMP</b></p> <p style="text-align: center;">para que conste donde corresponda, expido el presente certificado en,</p> <p style="text-align: center;">Zaragoza, a 09 de julio de 2013</p> <p style="text-align: center;">Responsable del curso _____ Alumno _____</p> <p style="text-align: center;"><small>Este diploma carece de validez oficial acreditando la formación realizada con carácter privado</small></p> <p style="text-align: center;"></p>	<p style="text-align: center;"><b>CONTENIDO</b></p> <p><b>Unidad I: Introducción</b></p> <ul style="list-style-type: none"> <li>○ Introducción a Nanotecnología</li> <li>○ Termoplásticos, visión general</li> <li>○ Introducción a métodos de extrusión / inyección de moldes</li> </ul> <p><b>Unidad II: Nanotubos de Carbono (CNTs) y su uso en el sector plástico</b></p> <ul style="list-style-type: none"> <li>○ Métodos de producción de nanotubos de carbono</li> <li>○ Propiedades de nanotubos de carbono y sus derivados</li> <li>○ Aplicaciones Comerciales</li> <li>○ Uso de nanotubos de carbono en compuestos</li> </ul> <p><b>Unidad III: Extrusión &amp; Moldeo por Inyección, incorporación de CNTs</b></p> <ul style="list-style-type: none"> <li>○ CNT Masterbatches             <ul style="list-style-type: none"> <li>• Diferentes componentes</li> <li>• Beneficios / costes</li> </ul> </li> <li>○ Definición de parámetros</li> <li>○ Problemas y soluciones del procesado de composites de CNT</li> <li>○ Retos y futuras aplicaciones de materiales con CNT</li> </ul> <p><b>Unidad IV: Nanotubos de Carbono: Seguridad, salud y medioambiente</b></p> <ul style="list-style-type: none"> <li>○ Datos toxicológicos y ecotoxicidad</li> <li>○ Manipulación durante síntesis y desarrollo de producto</li> <li>○ Buenas prácticas en el manejo de CNT</li> <li>○ Visión general de normativas nacionales y europeas</li> </ul>
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## ACCREDITATION TOOL (Validation)

As it was indicated in the project proposal, the contribution of the project to national priorities was the promotion of European Credit system for Vocational Education and Training (ECVET). This system aims for better compatibility between the different vocational education and training (VET) systems in place across Europe and their qualifications.

However, although this aim has been achieved, the accreditation tool of the TANOCOMP project e-Learning methodology is no-official. This is because the accreditation is not certificated by any agency/institution with the ability to certificate this kind of documents. Spite of this tool is a no-official accreditation and does not offer an ECVET standard for the categorization with ECVET credit points, consortium offers an accreditation that **is supported by very important reasons that validate the idea of an accreditation like this**, to sure that a person has passed the whole TANOCOMP e-Learning training. Examples of these reasons are: (1) accreditation is supported by 4 partners (consortium) who have a broad expertise in (nanotechnology, manufacturing processes, NTCs, security, materials, etc.), (2) The e-Learning methodology: scope of the contents and exercises as well as knowledge beyond the state of the art, (3) excellent acceptance and interest of the e-Learning platform by a diverse kind of stakeholders (enterprises, public entities, associations, research and development centres, etc.) which belong to different sectors such as: plastic industry, automotive, nanotechnology, energy, ICTs, composites, aeronautical, wood, food, packaging, sports, etc. and (4) the learning objective of TANOCOMP was supported by European Commission through Lifelong Learning Programme.

1) This validity of this accreditation is supported by 4 partners (consortium) who have an broad technological expertise in:

- Nanotechnology. (GLONATECH, AITIIP)
- Plastic part manufacturing processes (injection, extrusion, nanocomposites preparation, etc.) (AITIIP)
- Production of very high quality multi-wall carbon nanotubes (up to 98%) and single-wall carbon nanotubes. (GLONATECH)
- Chemical treatment of carbon nanotubes. (GLONATECH, AITIIP)
- Knowledge in innovative solutions. (SEZ, GLONATECH, AITIIP, MARKETMENTORO)
- Knowledge in carbon nanotubes: ability to enhance the properties of plastic parts (mechanical, thermal and electrical), rheology, additivation, etc. (GLONATECH, AITIIP)
- Knowledge of the target sectors to manufacture parts made of NTC reinforced materials (aeronautics, car industry, self protection, orthopedics, pharmaceuticals, electronics, energy etc.). (GLONATECH, AITIIP)
- Designing and development of training courses (online, workshops/seminars, showcashing, etc.). (AITIIP)
- Trainings and analysis/exploitation of new markets and solutions. (SEZ, GLONATECH, AITIIP, MARKETMENTORO)
- Broad net of stakeholders from diverse sectors. (SEZ, GLONATECH, AITIIP, MARKETMENTORO)

In addition, it is important to stress that AITIIP is an official formative centre of INAEM (Aragonese Institute of Employment) of the Government of Aragon (Spain) and also develops training software and platforms to support its training activities.

In definitive, the tool is the accreditation of an e-Learning platform as result of an European project developed by four partners from different European countries: Germany (SEZ), Greece (GLONATECH), Spain (AITIIP) and Cyprus (MARKETMENTORO). This is remarkable for the accreditation of the training around Europe in order to, between others, to boost the mobility of workers in Europe and to achieve more specific skills for them.

2) The e-Learning methodology: scope of the contents and exercises as well as knowledge beyond the state of the art.

The e-Learning methodology is the result of the execution of a complete planning of activities to achieve a methodology aligned with the formation objectives of TANOCOMP project (objectives established by the European Commission - National Agency and the Lifelong Learning Programme Guide for 2011-).

**Units:**

The methodology is based on 4 learning units.

**Learning Unit 1: Basics.**

**Learning Objective: Establishing a common knowledge base on nanotechnology in plastics for all learners.**

**Technical contents: 40 slides/unit**

**Contents:**

- Introduction to Nanotechnology.
- Overview of thermoplastic materials.
- Introduction to extrusion / injection moulding process.

**Exercises: 10 slides/unit**

**Duration (5min/slides): 4.2 hours**

**Learning Unit 2: Carbon Nanotubes (CNTs) and their use in the plastics sector.**

**Learning Objective: Get acquainted to CNTs and their benefits to the plastics industry.**

**Technical contents: 40 slides/unit**

**Contents:**

- Carbon nanotube production methods.
- Properties of carbon nanotubes and their derivatives.
- Commercial applications.
- Use of carbon nanotubes in composites.

**Exercises: 10 slides/unit**

**Duration (5min/slides): 4.2 hours**

**Learning Unit 3: Extrusion & Injection Moulding and incorporation of CNTs.**

**Learning Objective: Getting acquainted to the production chain of thermoplastics with CNTs.**

**Technical contents: 40 slides/unit**

**Contents:**

- CNT Masterbatches (different compounds, benefits / costs).
- Parameters definition.
- Problems and solutions of processing CNT composites.
- Challenges and future applications of CNT based materials.

**Exercises: 10 slides/unit**

**Duration (5min/slides): 4.2 hours**

**Learning Unit 4: Carbon nanotubes: Safety, health and environmental issues.**

**Learning Objective: Providing an overview on safety, health and environmental issues on the handling of nanotechnology.**

**Technical contents: 30 slides/unit**

**Contents:**

- Toxicological and eco-toxicity data.
- Handling during synthesis and product development.
- Awareness and good practice in CNT handling.
- Overview of national and European regulations.

**Exercises: 5 slides/unit**

**Duration (5min/slides): 2.8 hours**

**TOTAL: 175 slides (15,4 hours >> 2 day training)**

**Exercises:**

Within TANOCOMP training, all learning units will end with exercises to test the learner's comprehension of the training units' content. The successful completion of the exercises is mandatory in order to proceed to the next unit. In following pages how the diploma is achieved is explained in detail.

*For more information, please see R04. Learning Methodology.*

**3) Excellent acceptance and interest of the e-Learning platform by a diverse kind of stakeholders:**

Thanks to the dissemination tasks, the accreditation not only has the demonstrated support of the whole of plastic industry, but too of public entities and associations which have known the new online e-Learning platform and have shown an important interest into the important benefits to achieve in companies to increase the knowledge in nanotechnology with the final objective of designing and developing new products based on plastic reinforced with carbon nanotubes. The main target TANOCOMP stakeholders are:

- Chemical engineers
- Processing engineers
- Operations managers

Having an influence on the processing steps in the company related to injection moulding and extrusion, therefore working with thermoplastics and belonging to the plastics sector supplying plastic raw material or plastic parts and plastic products to the following TANOCOMP target sectors:

- Plastic industry
- Automotive industry
- Information and Communication Technologies
- Energy
- Entities for material science.
- Aeronautical sector
- Sports equipment
- Packaging
- Household goods

Beyond the project's target scope, the accreditation can as well be obtained by and learner, whose companies' products supply any of the following sectors:

- Energy (Batteries, Electric Vehicles (EV)).
- Chemical sector dedicated to nanomaterials or advanced materials
- Toy industry
- Metal industry
- Textile industry
- Food Safety
- Furniture and Wood
- Environment
- Electronics
- Photonics
- Agriculture
- Transport
- Logistics

4) The learning objective of TANOCOMP was supported by European Commission through Lifelong Learning Programme.

Thanks to TANOCOMP project, the consortium has achieved a remarkable contribution to assemble the available knowledge relating to nanotechnology (especially carbon nanotubes, CNTs) to the plastics sector around Europe. The TANOCOMP e-Learning platform and its contents will have a positive impact on the high specific technological growth in Europe through their stronger involvement in the area of polymer nanocomposites.

#### **ACCREDITATION TOOL (Use)**

The ownership and use of the Accreditation Tool allows to users:

a) To certificate specific skills for workers of entities such as companies, research and development centers, universities, etc. These specific skills are mainly aimed to the following competences:

- Chemical engineers
  - Processing engineers
  - Operations manager
- and beyond as well to:
- Part Design engineers
  - Technical personnel
  - Product development engineers
  - Researchers of plastic part manufacturing processes
  - Nanotechnology researchers

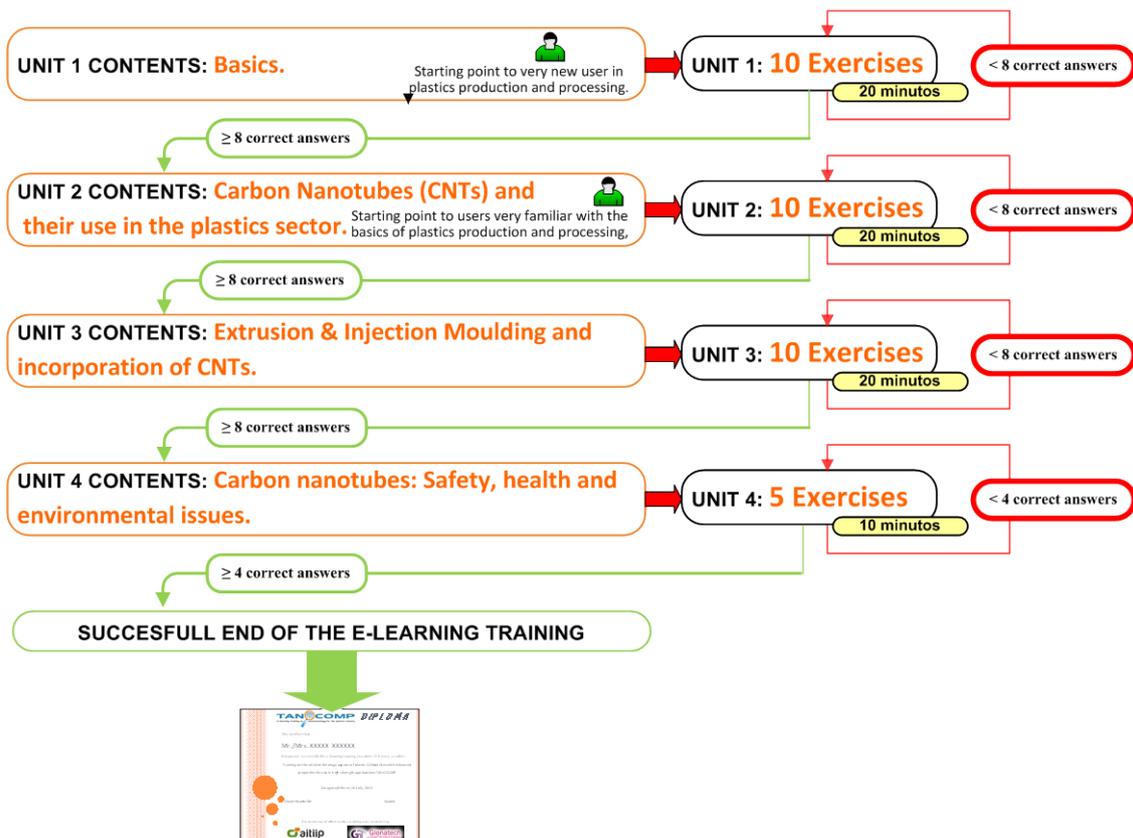
b) Contribution to the mobility of workers thanks to be available the unique knowledge that has been mentioned above. As a consequence, Member States and entities workers could promote the mobility of them, aligned with the intentions of EU to adopt a Directive. By this way, EU citizens will be benefited (look for a job in another EU country, stay there or to be back in country of origin, enjoy equal treatment with nationals in access to employment, working conditions and all other social and tax advantages, etc.).

## HOW TO OBTAIN ACCREDITATION TOOL?

This brief part of the document describes how to obtain the diploma which accredits (without official value) the overcoming of the theoretical contents of the e-Learning formation that are results of TANOCOMP project.

This course was designed with the goal that students acquire an overview of the use of carbon nanotubes (CNTs) and their potential applications, and how they can be introduced into the traditional processes of plastic processing.

As mentioned below, the e-Learning training was divided into four units and it's necessary to complete successfully all the units' exercises to pass the course as a whole. The methodology to overcome the complete e-Learning course and to obtain the accreditation as user who has passed the training is shown below:



After having revised the content of each unit you can proceed to the unit's exercise section. A random set of 10 exercises (5 exercises in unit 4) will be presented. To successfully complete the exercises, at least 80% of the questions have to be answered correctly.

If an user have failed to achieve 80% of the exercises, he could try to complete them again. For each set of exercises, 3 attempts are the maximum allowed. It's important to stress that the time limit to complete the exercises of Unit 1-3 is 20 minutes, for unit 4 10 minutes.