European Cooperation
in Science and Technology
- COST -

Secretariat

Brussels, 8 December 2011

COST 4182/11

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action MP1105: Sustainable flame retardancy for textiles and related materials based on nanoparticles substituting conventional chemicals. (Acronym : FLARETEX)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 183rd meeting on 30 November 2011.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action MP1105
SUSTAINABLE FLAME RETARDANCY FOR TEXTILES AND RELATED MATERIALS BASED ON NANOPARTICLES SUBSTITUTING CONVENTIONAL CHEMICALS. (ACRONYM : FLARETEX)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to form a European multidisciplinary Knowledge Platform on Sustainable Flame Retardancy to facilitate the rapid development of fire safe textiles and related materials of low toxicity and ecotoxicity, using all the available technologies.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 80 million in 2011 prices.

4. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

Replacement of existing flame retardants (FR) with sustainable and environmentally friendly alternatives for textiles in domestic, safety, transport (automotive, rail, aerospace and marine), civil emergency and military, construction and other industries requires a multidisciplinary approach from textile technology to the physics and chemistry of fire. This COST Action will create an international multidisciplinary scientific and technology network on Sustainable Flame Retardancy, developing new innovative flame retardants with low fire toxicity and environmental impacts and halogen-free. A COST Action is ideal to promote the existing cooperation in flame retardancy research, in order to accelerate growth to keep Europe leading the world in this crucial area, taking into account sustainability, safety and health, and to facilitate its commercial exploitation in Europe. It will stimulate European cooperation and technology transfer to industry with valuable input from (inter)nationally funded research via Working Group meetings, workshops, conferences, Training Schools and Short-Term Scientific Missions (STSM) for early stage researchers (ESR), etc.
Keywords: Non-toxic flame retardants (FR), environmental impact and Life Cycle Analysis (LCA), sustainable FR systems, textile (related) materials, halogen-free flame retardants

B. BACKGROUND

B.1 General background

The flame retardancy of textiles and related materials is a crucial feature for their use in several applications where fire safety and protection of the individual are essential factors. Protection of people from fire is fundamental; fire fighters and emergency personnel need protection from heat and flames during their duties. Floor coverings, beddings, curtains, upholstery, etc. are the origin of most fatal domestic fires and thus require proper protection. Military and mass transport applications (air, sea and rail) where escape options are limited, have an even greater need for flame retardant materials.

Despite remarkable progress in science and technology, it is estimated that still ca. 100,000 people annually die in fires. Most fire deaths result from inhaling smoke and toxic gases and thus fire safe materials must address issues of both flammability and fire toxicity. The cost of fire is ~1% of GDP

(Gross Domestic Product) within the EU and generally within other developed economies, so, further development of better, fire-safe environmentally friendly flame retardants (FRs) is urgently needed. It is imperative that the development of products optimised for fire safety and environmental performance take into account legislative developments and also the evidence base that currently exists in Europe and the new European Chemicals Agency (ECHA), with its responsibilities in support of the EU process for Registration, Evaluation, Authorisation & restriction of Chemicals (REACH). Development of fire retardant textiles is extremely challenging, requiring a multidisciplinary approach. There are insufficient experts in the field to address the myriad of fire retardant application problems, and so cooperation and collaboration has become the standard.

COST really provides a perfect framework as it allows networking on a wider scale than any other funding programme, which is essential in such a multidisciplinary field. It has the flexibility not noticed in other programmes to allow the addition of partners during the Action, provides funds for scientific exchanges and promotes the proactive dissemination of the knowledge and innovations arising out of the Action. The short-term exchange of researchers between project partners can be a crucial element in research collaboration with remarkable and significant benefits surpassing both new fundamental knowledge and practical/applied developments.

B.2 Current state of knowledge

The first generation of textile flame retardants were metal salts often comprising phosphorus and leading to organophosphorus FRs. Halogen containing FRs have been applied since the 1940s when they were developed for tents during World war II. The significant usage of brominated flame retardants (BFRs) within textiles was driven in the USA during the 1970s by the development of surface coatings for polyester/cotton blends and later in the UK by the Furnishing Regulations of 1988 which enabled the development of BFR-containing back coatings which are effective on and applied to all domestic furnishing fabrics. This then drove their use in contract furnishings within and outside the UK. Environmental concerns of BFRs were first raised during the late 1980s when their possible conversion to dioxins during incineration was identified. Subsequently, it is their use in combination with antimony trioxide that added to these concerns for environmental behaviour as articulated by the US NAP (National Academies Press) 2000 risk analysis of FRs in furnishing fabrics for example.

A number of potentially toxic chemicals are still key components in fire retarded materials (especially textiles, plastics, foams, electrical components, automotive products, …). The Water Framework Directive 2000/60/EC, with an annex about the "List of priority substances in the field of water policy", identifies brominated diphenylethers (BDE, the most used halogenated compound) as Priority Substances (PSs), and PentaBDE as a Priority Hazardous Substance (PHS). These substances are considered to be Persistent Organic Pollutants (POPs), such as Poly-Chlorinated Biphenyls (PCBs). Hexabromocyclododecane (HBCD) widely used in textile back coatings has recently been listed by the Stockholm convention on POPs. Various studies have shown that concentrations of BFRs including DecaBDE are increasingly present in the environment and in human tissue as a consequence of their bioaccumulative properties. Given these concerns, it is not surprising that both consumer groups and health agencies are driving the need to identify a number of promising alternatives to halogen- and antimony-containing flame retardants currently applied during (textile) finishing or for the production of flame retardant fibres and yarns.

Environmental concerns over the use of FR systems have enhanced the need for effective alternatives with decreased toxicological and environmental impacts. This for example has resulted in the development of silicon-based additives and intumescents as possible candidates. The latter intumesce (i.e. swell) when exposed to direct flame impingement and high temperatures. The surface char that is formed by intumescence insulates the substrate from flame, heat and oxygen. However, they are not effective in the gas phase where brominated FRs exert their real advantage. Therefore, although promising, the fire protective power of these intumescent FRs is not always reliably effective, while they do indeed confer an environmental advantage.

The use of rather large amounts of flame retardants in a material in order to generate flame retardancy or self-extinguishing effects is a practical concern. Many environmentally benign fire retardants, such as aluminium hydroxide and magnesium hydroxide are only effective at loadings up to 50% and even more. This is not a realistic alternative for most textile applications (problem of handle!). Another concern is the impact of fire retardant systems on the acute toxicity of the fire effluents in terms of toxic product yields and toxic potency, toxic hazard development in full-scale fires and subsequent toxic, environmental hazards.

Any new FR should not only match the FR performance of the conventional FR it replaces, but must also be of low(er) smoke toxicity, pose no environmental concern and have guaranteed durability. It should also be cost-effective and require minimal investigation under REACH.

The inclusion of particulate nanomaterials (nanoparticles, nanoclays, nanotubes, etc.) has been shown to improve the fire retarding performance of textiles, notably by reducing the peak heat release rate and/or reducing burning rates and burning times. Moreover, current evidence suggests that these nanomaterials might be used in relatively low quantities and could be coupled with low amounts of "common" FR by exploiting significant synergistic effects. The hybrid organic-inorganic materials (HOIMs) show the properties of both phases. Therefore, the thermal stability at high temperatures, a property of the inorganic constituents, can be combined with the flame retardancy of organic intumescent phosphorus-based compounds, for example. By optimising nanoparticles for flame retardancy, the problems of toxicity, safety and environmental impact can be tackled in novel and innovative ways. Nanoparticles already considered as possible flame retardants are (layered) silicates, polyhedral oligomeric silsesquioxanes (POSS), carbon nanotubes, metal oxides, …

Outside Europe, a renowned institute in the USA has examined the current state of FR research highlighting the work on nanobased materials. This study indicates very clearly the importance placed on this kind of research within the USA, and more particularly the Environmental Protection Agency (EPA, http://www.epa.gov/) is expending considerable resource in this area. Recently, China has also shown great interest in (textile) flame retardancy and a large number of research papers come from Chinese universities.

B.3 Reasons for the Action

This COST Action will develop a knowledge platform on fire safe textiles and related materials. The textile industry, in particular SMEs (small and medium enterprises) in Western Europe, nowadays are focusing their expertise in niche areas. In parallel, the academics are also developing novel technologies and materials. There are many research groups and industries working on fire retardant textiles, but there is no real mechanism of bringing them together. This Action can bring them together. Through this programme the benefits will be multifold as shown below:

Scientific:

- Coordinate national and European-wide research activities on sustainable FR, thus strengthening the European research capacity through cooperation, to ensure the future of our global leadership in this area.
- Establish a European Knowledge Platform on Sustainable Flame Retardancy involving academia, research institutions and industry, crucial to the success of many high value-added manufacturing industries.
- Enhance research that addresses the functional, environmental and economic impacts of novel sustainable FR through life cycle analysis (LCA).
- Develop new research projects to address the identified scientific gaps, facilitating the involvement of industry

Societal:

- Generate data on the health and environmental impact derived from the production, use, recycling and/or disposal of FRs
- Drastically reduce the loadings of or totally replace actual FR chemicals believed to be harmful to humans or the environment
- Contribute to the 'Code of Conduct for Responsible Nanosciences and Nanotechnologies Research' since it intends to ensure that FR nanotechnologies are developed in a safe manner
- Intensify consumer concern regarding the use of sustainable non-toxic FR, which impact adequate levels of fire safety
- Contribute to the training of specialists with expertise in a topical, high performance domain

Technological:

- Ensure that partners have the most up-to-date expertise on novel FR systems

- Avoid disruption to technological processes by investigating issues of sustainability and communicating up-to-date safety information and recommendation of protective measures, ultimately through standardisation
- Fast technology transfer to industry

This Action is really needed for both European economic/societal needs and scientific/technological advances. Development and commercialisation of new technologies will certainly boost economy. Fire safe textile materials will help in socio/economic needs of the society at large.

B.4 Complementarity with other research programmes

This COST Action is complementary to a number of national and European-wide research activities on flame retardancy on textiles and related materials. It is unique in the sense that it will give the opportunity for a European-wide networking (and even beyond) and exchange of information. In addition to various national and bilateral research projects, the research funding of the partners is guaranteed through the following current European research projects:

- SAFEPROTEX “High-protective clothing for complex emergency operations” - FP7 NMP, 2010-2013
- SUPERTEX “Sustainable Flame Retardant Technical Textile from Recycled Polyester” - CIP-ECOINNOVATION project, 2011-2014
- INTIMIRE “Intumescent materials with improved fire retardant and flame resistant properties for building and transport applications” – FP6 SME, 2010-2013
- LAYSA "Multifunctional layers for safer aircraft composite structures” – FP7 Transport, 2008-2011
- NANOLAC - Interreg IV, 2008-2011
- MINANO “New high-quality mined nanomaterials mass produced for plastic and wood-plastic nanocomposites” - FP7-NMP-2010-EU-Mexico, 2010-2013
- HEFEST “Smart fire retardant coatings based on intumescent nanocomposites” - FP7 SME, 2009-2011

- PP-MIPS “An innovative phosphorus rich intumescent oligomer enabling commercially competitive high performance halogen free fire protection of polypropylene” - FP7 SME, 2010-2012
- STAY COOL “Lightweight, long endurance body cooling for fire fighters” - FP7 SME, 2011-2012
- NEPHH “Nanomaterials related environmental pollution and health hazards throughout their life cycle” - FP7 CP-FP, 2009-2012
- DEAM “Development of a European Ablative Material for Heatshields of Sample Return Missions” - European Space Agency.

It is worthwhile to refer to the current FP7 NMP call topic “Halogen-free flame retardant materials” just to show the real importance of this COST Action.

C. OBJECTIVES AND BENEFITS

C.1 Main/primary objectives

The aim of the Action is to form a European multidisciplinary Knowledge Platform on Sustainable Flame Retardancy to facilitate the rapid development of fire safe textiles and related materials of low toxicity and ecotoxicity, using all the available technologies. In particular, this platform will help to promote cooperation between researchers from different scientific disciplines, efficiently exchanging ideas and strategies in order to lead developments in fire safety, fire retardants and environmentally friendly fire retarded textiles and related materials.

C.2 Secondary objectives

This aim will be achieved by meeting each of the following objectives:

1. To identify and bring together various research activities occurring in this area in different academic and industrial sectors and different scientific disciplines (such as chemistry, physics, materials science and engineering) within Europe and worldwide.
2. To address aspects related to technical, environmental, economic, medical and societal issues relating to the use of flame retardants.

3. To organise activities to allow the coordination of research on a European level, avoiding duplication of efforts and linking industry and (academic) research. The latest results from RTD will be exchanged among the participants from universities, research institutions and industry, and the benefits used for industrial applications guaranteeing efficiency, low toxicity, environmental safety and durability (time and/or environment exposure).
4. To facilitate the commercialisation of the novel research products/processes developed by academics through SMEs as well as influence the main European industrial flame retardant textile interest.
5. To facilitate the formation of consortia to develop new research projects for funding from national/EU funding bodies
6. To establish a fully functional network where each participant is aware of the activities, expertise and previous experience of other members working in their area. This is particularly important for industrial participants who frequently have less access to academic journals and conferences and do not have the time to find out what they do not know.
7. To establish a repository of published research on fire retardant textiles (to include books, journal articles, conference proceedings, patents, …)
8. To promote placements and exchanges of scientific personnel across the network

C.3 How will the objectives be achieved?

The means to achieve these objectives are summarised below, giving quantitative figures for evaluation:

- Networking will reach at least 60 partners in 23 countries (44 partners in 20 countries have already shown interest in this Action)
- Networking will be extended to at least 30 companies (15 companies have already shown interest in this Action)
- Minimum 10 collaborative, transnational projects on specific topics will be generated and coordinated

- One Management Committee meeting per year will be held to facilitate better and more intense communication among members
- One Working Group (WG) meeting/workshop per year and per WG will be organised to follow the progress of the WGs
- A standardisation meeting will be called twice during the Action
- A dedicated website will be created and information material prepared and distributed
- Organisation of 3 training schools for intensified training and education of early-stage researchers (ESR)
- 25 Short Term Scientific Missions (STSM) will be performed
- 0 IPR (Intellectual Property Rights) contracts will be initiated for further exploitation by SMEs
- A biennial conference of several days will be organised from which at least one full set of peer-reviewed papers will be published. Two such sets of papers are envisaged during the lifetime of this project.
- 50 or more publications will be issued in peer reviewed journals as a result of the initiated scientific projects and of the biennial conferences.

C.4 Benefits of the Action

The impact and benefits will include:

- The establishment of a permanent European-wide network of FR-interested parties comprising the major European research providers and industrial interests servicing the European textile consumer.
- A number of cross-national research consortia comprising academia and industry.
- At least two major EU grants will have been successfully achieved by these consortia during the project lifetime.
- Improved public awareness of the activities being undertaken to improve FR textile environmental sustainability via a dedicated website.

The greatest short term benefit will be the reduction in the tragic and unnecessary loss of life and serious injury from fire and the economic benefits associated with reduced fire losses (lower insurance premium, avoidance of continuity losses, bankruptcy, etc.) . Without such a network, developments in safe(r) fire retardants will be delayed, possibly abandoned or at least slowed down.

In the longer term the millions of tonnes of endocrine disrupting halogen containing FRs which are already widely distributed across the biosphere will ultimately need to be cleaned up, since their persistence over the last 40 years suggests that they will not decay on their own. The cost of such clean up, if deemed necessary, would probably dwarf the European textile industry, and the sooner production is halted, the less likely such an extensive clean-up will be necessary.

In general, this COST action will generate a stronger link between academia and industry in order to promote the latest FR solutions and technology commercialisation to the benefit of the competitiveness of the European companies on the global market.

C.5 Target groups/end users

Target groups and end users will include:

- Every European academic institution currently having active research programmes into all aspects of FR textiles and related materials and their impact on society.
- Every European research centre undertaking relevant research activities.
- Major non-European research centres, both public and academic, with FR interests.
- All multinational companies having European facilities that involve the manufacture and/or application of flame retardants to fibres, textiles and related products.
- SMEs across Europe having manufacturing and processing interests in FR fibres, textiles and related products.
- Early-stage researchers (graduates, PhD students, young researchers) as future developers and users of the technology.
- The general public that will benefit from dissemination activities and open access to the FLARETEX website.

Universities, research organisations as well as industrial companies (including SMEs) contributed to the preparation of this COST Action.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

This COST Action will generate and coordinate a number of research projects aiming at:

- Identification of the safer alternative to halogenated and antimony based FRs.

- Development of new and sustainable nanobased FR systems for application in textile and related materials.
- Analysis of their effectiveness, durability, (smoke) toxicity and particularly environmental impact (LCA).
- Improved surface treatment (plasma, enzymes, ultrasound, UV, etc.) and application processes (coating, spinning, sol-gel, micro-encapsulation, (photo) chemical, etc.) for FR.
- Explanation of the FR mechanism of action of nanostructured materials (condensed vs. gas phase activity, intumescent effect, (nano)morphology, kinetics of degradation, …).
- Drawing up of testing methods, performance standards and durability requirements for FR in different sectors (protective clothing, automotive, construction, packaging, etc.).
- Study of the synergistic effect of combining nanomaterials with conventional FRs.
- Development of a modelling tool, based on the existing knowledge of FR and new scientific results, to be used by industry to predict the properties of newly designed products in an optimal way.
- Characterisation, safety aspects, quality assurance, property database.
- Scaling up and commercialisation.

The projects will be arranged vertically across these research areas so as to obtain the needed interactions and interdisciplinarity. Moreover, a number of cross-cutting activities are relevant:

- Safety and ethics
- Sustainability and recycling

- Dissemination
- Intellectual Property Rights (IPR)
- Technology transfer
- Outreach activities

The latest science and engineering will be applied to come to novel flame retardants which are more environmentally benign and safe(r). A broad approach will be utilised to find optimal materials based on e.g. molecular modelling of all or most parameters of the flame retardant chemicals and the combustion process. Not only the macroscopic aspect but also the nanoscale characteristics in particular towards the efficiency of novel flame retardants combined with conventional FRs and the substrate (or matrix) will be intensively studied by appropriate physico-chemical methods (thermovision, solid state Nuclear Magnetic Resonance (NMR), …). Specific compounds based on (nano)clays and condensed phase flame retardants are very promising provided the optimal particulate dispersion is achieved.

The intumescence phenomenon for flame retardants will be optimised and also made “greener” (footprint!) by the use of specific carbon components from renewable sources (lignin, starch, …) providing later on a carbonised top (surface char) layer reducing heat build-up and retaining decomposition products more adequately.

New thermal decomposition and heat transfer models will have to be developed. Also mass transfer models have to be optimised when novel FRs are put forward. This will require a better identification and understanding of material and structural variables controlling the fire performance.

Modelling and computer simulation will be applied to decide on the most attractive directions in flame retardancy of new molecules and compounds. Testing will play a critical/vital role in validation which may lead to new and proper flammability standards; also as a result of advanced computer models.

The research in this Action will be carried by a large number of renowned laboratories, being multidisciplinary in expertise and fully European based. Key researchers having the necessary complementary knowledge will support this Action and will cooperate through a network with permanent interaction. This will enhance the exchange of ideas and increase the efficiency remarkably. Feedback from various tasks will be timely; cross-fertilisation of new ideas and transfer of vital knowledge will be permanent and lead to an innovation boost!

D.2 Scientific work plan - methods and means

The programme will be organised in 4 Working Groups (WG):

1. Novel flame retardants: new and environmentally friendly (halogen-free) nanobased FR systems, synergistic effects derived from combining nanoparticles with conventional FRs and their potential effectiveness.
2. Toxicological/environmental aspects: FRs obtained in WG1 will be investigated for their fire toxicity, ecotoxicological and environmental impacts (LCA).
3. Processing/Applications/Commercialisation: application processes (such as conventional and atmospheric plasma coating, spinning, sol-gel, (photo)chemical, …) will be studied, developed and optimised. Work in this group will facilitate the mechanism to commercialise the best products/processes through intensive cooperation with the industrial partners.
4. Testing/Standardisation: according to the requirements needed for the different application (sub)sectors, new test methods and performance standards can be developed. Durability tests for the novel FR will be standardised as well.

The methods and means of the scientific work plan will be based on the activities of these four Working Groups whose actions are largely sequential. These interrelated activities are based on a strong pan-European cooperation which will guarantee fast and successful developments in a very challenging field.

In Working Group 1 novel flame retardant products will be searched for or investigated. Contrary to existing ones, particularly environmentally friendly systems will be developed. A rather large number of FRs will be scrutinised avoiding the halogen containing chemicals. Focus will be on flame retardants with increased effectiveness of different nanoparticle species, particularly in combination with “conventional” flame retardants, as well as fully novel flame retardant components (bicomponent fibrous structures, bio-based flame retardants, …). Improvements in mechanical properties and fire performance (effectiveness) at a relatively low cost are aimed at!

This research will provide large amounts of starting material for making textiles flame retardant. Molecular modelling of thermal degradation will be applied in order to get new insights into the mechanisms by which new FRs affect the flammability of textile (based and related) materials.

Working Group 2 will deal with toxicological and environmental aspects of the FRs developed under WG1. One of the reasons of this COST Action certainly is to bring the toxicity of the novel FRs to a (absolute) minimum taking into account the knowledge about the health and environmental risks associated with conventional FRs since the late 1980s. Toxicity, ecotoxicity and environmental impact (LCA) are the main elements to be investigated in WG2. The risks and benefits of using flame retardants in consumer products, i.e. textiles and related products (composites, plastics, …) will be analysed both qualitatively and quantitatively. Risks will also be studied from a point of bioavailability, i.e. the effectiveness of the containment of flame retardants by the textile substrate (matrix). It is important that each flame retardant is considered individually and in the context of its incorporation into consumer products. In general, the appropriate human exposure and environmental life cycle risks will be assessed.

In Working Group 3 the novel flame retardants will have to be applied to textiles or textile related materials such as composite (fibre based) products. Several application technologies (padding, dipping, …) are available, but it is expected that more specific treatments (sol-gel, plasma, …) of the substrate (textile material) will be more appropriate to make the best out of the newly developed FRs. Improved surface treatments will be investigated such as plasma, corona, ultrasound, UV, enzymes, ... which will generate a much better adhesion of the FRs to the polymeric systems out of which the fibres or textile materials are built. Also grafting of flame retardants and copolymerisation technology are straightforward to be applied as well as dispersing selected FRs (clays, …) in spinning dopes plus the use of photochemical actions to stabilise flame retardants onto textile materials. The general aim is to minimise the amount of novel FRs but still assuring the best fire performances of the treated materials. The application methods will have to be chosen/adapted in such a way that scaling up to an industrial or commercial process is obvious!

Working Group 4 will deal with testing, standardisation and safety regulations. Public concern over fire safety has resulted in legislations to control flammability specifications. The fire performance of a material can be quantified on the basis of observations and measurements of its response in laboratory tests. A large number of tests are available and each test is (often) unique. New tests might be developed, new standards may be proposed and decided upon at the standardisation meetings. Tremendous progress has been made in the past few decades in our understanding of the physics and chemistry of fire, mathematical modelling of fire phenomena and measurement techniques in order to predict the performance of a (textile) material in a range of scenarios. However, there will always be materials that exhibit a behaviour that cannot be captured in bench-scale testing and computer models. The fire performance of those materials can only be determined in full-scale tests! Still current small- or large-scale flammability tests are not fully able to reliably predict fire scenarios. Tests might be superseded by fundamentally based small-scale test methods for making material property measurements that can be used as input to validated end-use computer models. Testing of course will be done in strong cooperation with partners from industry as well as from research institutes and the academic world.

E. ORGANISATION

E.1 Coordination and organisation

The COST Action will be coordinated by a Management Committee (MC) as described in the "Rules and Procedures for Implementing COST Actions" (doc. COST 4154/11). The Action Chair and the Vice Chair will be elected at the "kick-off" meeting at the start of the Action. In addition, scientific coordinators for the Working Groups, an STSM Coordinator, a Dissemination Officer (also responsible for the Action website) and a Responsible for Gender balance and Involvement of Early-Stage Researchers (GB-ESR Coordinator) will be appointed. Efforts will be made to encourage gender balance and representatives of early-stage researchers will also be invited to the MC.

To support the MC, a Steering Group (SG), composed of the Action Chair, Vice Chair, Working Group Chairs, STSM Coordinator, Dissemination Officer and GB-ESR Coordinator, will be established to manage the day to day operations of the Action. This group will prepare detailed work plans for the specific activities of the Working Groups and a financial plan to adequately share the resources within the Action budget, to be approved by the MC. The SG members will ensure that in their periodic progress reports mention is made of any advances in their areas, which could lead to exploitation. The SG will set clear milestones and will prepare the documents for the annual MC meetings.

The MC will formally meet annually, typically at workshops or conferences organised by the Action. The Steering Group will meet every 6 months and in addition will regularly exchange information via e-mail and web based facilities.

The MC will ensure strong interactions between WGs to obtain cross-fertilisation and stimulate cooperation with related COST Actions (e.g. MP0701, MP0902, TU0904).

To support the coordination of national research programmes, this Action will endeavour to build on the existing nationally supported projects. To accomplish this, the Workshops/Conferences will, whenever possible, incorporate sessions covering activities across all the WGs and presentations on potential funding opportunities to actively promote the formation of consortia to bid for such funding.

A core element of building the network will be the exchange of researchers between participating groups through Short-Term Scientific Missions (STSMs). Significant efforts will be taken to encourage ESR participation and ensure gender balance. The Action Steering Group along with the STSM coordinator will ensure that there is a balance across all WGs and a focus on multidisciplinary interactions.

Further interaction between participating teams will be promoted through Training Schools (also aimed at ESR). These schools will not only cover the leading edge scientific and technological aspects of the research area, but will also endeavour to include additional broader modules on topics such as the importance of intellectual property and its appropriate management, entrepreneurship and the potential exploitation/commercialisation of research.

The Dissemination Officer will oversee the creation and maintenance of an Action specific website in accordance with COST Office requirements and will be responsible for dissemination activities as described in sections H1-H3.

This COST Action will be open for new partners and cover costs for the activities within the network, e.g. management, workshops, conferences, STSM and technology transfer to industry. The research itself will be carried out by the participating laboratories, funded through other sources.

The following major achievements are considered to be milestones for this Action : launch of the FLARETEX website, organisation of two international conferences and two standardisation meetings. The tentative schedule for the achievement of these milestones is given in the timetable in section F.

E.2 Working Groups

As specified in Section D.2, the following four Working Groups will be established :

- WG1 - Novel Flame Retardants
- WG2 - Toxicological/environmental aspects
- WG3 - Processing/Applications/Commercialisation
- WG4 - Testing/Standardisation

Each WG will have a Chair selected by and reporting to the Management Committee (MC)/Steering Group (SG). Each WG Chair will be a member of the Action Steering Group and will coordinate the activities of the WG, including organising workshops and Training Schools, making proposals for STSM, preparing contributions to annual reports and promoting joint publications.

The scientific programmes of the WGs will be carried out in close cooperation with other WGs and strong interaction between the members of these groups is expected.

The WG meetings and workshops will be organised combined with MC and SG meetings, in order to save time and to progress the work.

E.3 Liaison and interaction with other research programmes

This Action will have a strong interaction with other European national and international research programmes. The main topic of liaison and interaction will be on the Actions agenda and will accordingly be considered by the MC.

One of the topics of the FP7 NMP call for 2012 is “Halogen-free flame retardant materials”. The results of this call will be known in Summer 2012. An intensive collaboration with the selected project(s) is anticipated, e.g. by inviting project partners to present their research.

It will be possible for the Action to use the results of the Action MP0701 (“Composites with Novel Functional and Structural Properties by Nanoscale Materials”), which ends in March 2012. Further, cooperation is envisaged with the Action MP0902 (“Composites of Inorganic Nanotubes and Polymers”) and with the Action TU0904 (“Integrated Fire Engineering and Response”).

The interaction with other COST Actions and other European and international programmes will be maintained throughout the duration of the programme. Inviting experts from related research programmes to MC or WG meetings to use their expertise and recommendations may represent useful contributions to ongoing projects.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

During the preparation of the COST Action every effort has been made to gather a gender balanced mixed group of scientists. About half of the scientists consulted in the preparation of the full proposal are women. The objective is to maintain a good gender balance in the elected leading team members of the COST Action (Chair, Vice Chair and MC members, WG Chairs) and when selecting young researchers for STSM exchange and for presentations at workshops and conferences. Further the COST Action will encourage a strong participation of young women researchers in all its activities.

The Action will also proactively encourage the involvement of early-stage researchers (ESR). The different WGs will provide significant scope for STSM, with priority given to ESR (Master, PhD students and young postdoctoral scientists), to provide them with relevant interdisciplinary skills.

Further 3 Training Schools will be organised, specifically aimed at ESR, to aid the dissemination of the findings of the Action among this group of young scientists. In the organisation of workshops and conferences the MC will place emphasis on supporting the participation of ESR, inviting them to submit oral and poster presentations on their work in progress and offering a reduced registration fee for (PhD) students.

At the kick-off meeting a member responsible for Gender Balance and involvement of Early-Stage Researchers will be appointed to oversee and monitor the promotion of gender equality and the involvement of ESR in the Action: this responsible will annually report to the Management Committee and if necessary will make recommendations for further actions to promote gender and age balance.

F. TIMETABLE

The COST Action will run for a total of four years. Due to the nature of the COST framework of collaboration, the re-adjustment of the activities may become necessary and corresponding changes are subject to approval by the MC.

The scientific exchange programme and information exchange will go on at all times during the course of the Action. The tentative timetable and milestones of the Action are given in Table 1.

The Action will be initiated at the "kick-off" meeting in the beginning of year 1. The Working Groups will be formed and Working Group Chairs elected.

Table 1:Timetable and milestones (M) for the FLARETEX Action

	YEAR 1	YEAR 2	YEAR 3	YEAR 4
1st Quarter	Kick-off Meeting	SG-MC-Meeting/ Workshop	SG-MC-Meeting/ Workshop	SG-MC-Meeting/ Workshop
2nd Quarter	FLARETEX website operative (M)	Training School	Training School	Training School
3rd Quarter	WG-Meetings/ SG-Meeting/Workshop	WG-Meetings/ SG-Meeting	WG-Meetings/ SG-Meeting	WG-Meetings/ SG-Meeting
4th Quarter	Standardisation Meeting (M)	FLARETEX Conference (M)	Standardisation Meeting (M)	FLARETEX Conference (M)

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, CH, CZ, DE, DK, EL, ES, FI, FR, HR, IT, LT, NL, PL, PT, SE, SI, TR, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 80 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

The economic impact of the COST Action is expected to be considerable. Consumption in Europe of flame retardants that might be influenced by this Action is about 500,000 tons annually (source : European Flame Retardant Association).

H. DISSEMINATION PLAN

H.1 Who?

The main target audiences for dissemination will be :

- Researchers/partners in the COST Action consortium
- Other researchers working in the field (e.g. in related EU projects, COST Actions, …)
- Research institutes and academic units (in nearly related fields)
- Companies potentially interested in the production or application of flame retardant products, textiles and related materials (with a strong focus on SMEs)
- Industrial associations
- Policy makers and funding agencies at European, national and regional level
- Standardisation bodies
- Early-stage researchers (graduates, PhD students, young researchers) as future developers and users of the technology
- Potential users in different application areas: (protective) clothing, transport (railway, automotive, aeronautics), electronics, construction, medical sector, …
- The general public.

H.2 What?

The dissemination methods intended to be used are:

- A dedicated interactive website with two levels of access:
    1. Public section to allow broad dissemination of the Action. This will contain general information concerning the activities of the Action, a list of the participating groups (including description of their organisation, expertise, facilities, contacts and web pages), information about the events related to the Action topic internal as well as external to the Action (such as conferences, workshops, Training Schools, etc.), information and application form for STSM, publications and news. The website will also include a specific page where interested organisations can apply to participate in the Action upon approval of the MC.
    2. Password-protected section only accessible to the Action partners where the agenda, minutes of the meetings, annual reports, research results, etc. will be published. A data exchange server will be created for efficient communication between the partners.
- Electronic communication network: an internet discussion forum and an E-mail contact-network will be installed among the participating researchers from universities, institutes and industry.
- Scientific publications: articles in peer-reviewed scientific journals, books and conference proceedings, STSM reports, etc.
- Non-technical publications: distribution to the general public in terms of popular science articles in general press, sound or television broadcasts will be highly encouraged.
- Scheduled meetings will be organised: (industrial) workshops and conferences organised by the MC, contributions to other national and international conferences and symposia, participation in industrial forums.
- STSMs and Training Schools, including lectures by leading scientists and engineers from both academia and industry, to enable dissemination primarily to ESRs.
- The standardisation bodies will be invited to take part in the scheduled standardisation meetings.

H.3 How?

The specific target groups in H.1 clearly all have different requirements. The Dissemination Officer will, in cooperation with the Steering Group, draw up a strategic plan for dissemination, including measures to reach each of these groups, to be approved by the MC. This plan will describe which specific tools will be developed and which actions are needed to reach specific target groups, who will take care of it and when and where actions will be taken. This dissemination plan will be discussed and updated regularly during the life of the Action. At the end of the penultimate year of operations, the MC will include a revised dissemination plan as part of its annual report and present it to the Domain Committee (DC) for approval. The Final Evaluation Report shall also cover the dissemination and exploitation of the results in line with the DC's Terms of Reference.

All members will promote the Action on their websites (including a link to the FLARETEX and COST websites), and announce progress or achievements to the local and international media as appropriate. They will spread information on FLARETEX during participation at all kinds of events and in reports like an annual report, newsletters, etc.. Such announcements will refer to the COST framework and the international collaborations it facilitates. For this dissemination tools like a brochure, poster, short powerpoint presentation, etc. will be put available to all members.

Furthermore, links to the Action website will be included in the websites of AUTEX (Association of Universities for Textiles) and ENMat (European Network of Materials Research Centres), and the activities of the Action will be announced and reported in the ENMat Newsletter.

Workshops, Training Schools and conferences organised by the Action will be important dissemination channels to the wider scientific community. Whenever possible, such events will be held in conjunction with other major national or international events to enable dissemination to broader audiences and to increase the external visibility and publicity of the Action. The Management Committee will invite not only European but also the most prominent overseas researchers as speakers at the conferences and workshops.

To ensure that the activities of the Action are known to relevant industrial partners, dedicated topical workshops will be organised to bring together researchers from academia and industry, industry will be invited to the conferences and Action members will visit industrial sites.

Bilateral exchanges of researchers (via STSMs) will establish strong links between partners and will be an important instrument for internal dissemination of results and coordination of research programmes. Senior scientists will undertake short visits to give seminars and engage in research discussions, while extended visits will target ESR.

The main tools for disseminating the scientific achievements to the Materials Science community are the joint publication in peer reviewed journals and oral presentations at scientific workshops and conferences. Proper credit to the COST Action will be given in the acknowledgements. Subject to copyright and licensing arrangements, copies of publications arising from and supported by the Action will be lodged in the e-print repository of the COST Office.

Further it is expected that AUTEX members (31 members worldwide of which 29 in Europe) and possibly other academic partners will introduce the knowledge developed within this COST Action into regular Master programmes.