

AF3

Advanced Forest Fire Fighting

Deliverable 10.2.1 Environmental issues Report including Validation of Pellet Chemicals Report

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	DISSEMINATION LEVEL	
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1. SUMMARY:

This document proposes the necessary range of chemical properties of substances used or potentially used in the Fire Fighting Pellets systems typically provided by ELBIT and Capsules from PRO within the AF3 project.

This Deliverable is aimed to make sure that the application of systems proposed by AF3 are fully understood in their chemical composition, physical and hazardous properties.

Material Safety Data Sheet reviewed June 2015. Product is satisfactory for use. Combination of water and a plastic is satisfactory.

It has been stated that in the future, ELBIT may use a medium other than water in the pellets. ELBIT stated that if this occurs, the contents will be non-toxic. However, the project will need to be provided with data to support this (future). Furthermore, the compounds proposed for use in Capsules (Pyro) may vary in the future.

2. BACKGROUND:

The Fire Fighting systems under review will deposit water, potentially so far unspecified chemical substances and small amounts of plastic polymer from the pellet containment on the target site. Some aspects of this deposit may have detrimental effects. In that respect, chemical testing will be required to characterise the negative potential and to fully inform any user authority prior to their deployment. The Capsules will deposit water and fire retardants.

3. DETAIL:

- Complete chemical analysis of fire fighting compounds and any containment polymer used.
- To include authenticated Material Safety Data Sheets (MSDS) (see ref 1 AND ref 2 and ref 3). *Required Capsule information is included in the APPENDIX.*
- To cover effects on humans, flora and fauna and ecological impact.
- Review of potential hazards to users and distributors (e.g. in transport mode, at warehouse storage, pellet preparation operatives, potentially contacted persons in the fire zones (human health effects) and the environment. The material is biodegradable and poses low risk of environmental damage and water course effect. Hazards in the use and distribution mode are minimal. Proper handling is described in the MSDS.
- Biological and Chemical Oxygen Demand of firefighting compounds and any containment used. This is reviewed and the material poses a very low Oxygen Demand.

4. CONCLUSIONS:

The information provided is accurate and valid for the project to date. Therefore we can validate the Chemicals Report for Capsules. Since the Pellets from ELBIT contain water, a Chemicals Report is not considered necessary. Any changes of content of Pellets or Capsules will be communicated if they occur – for addition to a future chemicals report which will need attention.

5 REFERENCED DOCUMENTS:

Ref 1. REACH and Safety Data Sheets: This describes the necessary information for Material Safety Data Sheets.

<http://www.hse.gov.uk/reach/resources/reachsds.pdf>

Ref 2 European Directive 67/548/EEC. Classification labelling and packaging of dangerous substances;

<https://osha.europa.eu/en/legislation/directives/exposure-to-chemical-agents-and-chemical-safety/osh-related-aspects/58>

Ref 3 ELBIT provided Material Safety Data Sheets for pellet plastic:

Product Name	Composition	Comment on Environmental effect and animal exposure	Provided by	Manufacturer	CLP concerns?
C94/2	Starch, Polymers and additives	Largely bio-degradable. Low Hazard to fauna	ELBIT	IPRC	NO

APPENDIX: Capsules Chemical Report



Project acronym: AF3
Project full title Advanced Forest Firefighting
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Capsule Chemicals Report

Version: draft (rev. A)

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Authors	PYRO FIRE EXTINCTION S.L.
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Abstract	This deliverable includes the information relating to the Chemicals used in the capsules within the AF3 project. Note that if a user applies chemicals which are not listed in this report, it is not possible to predict potential impacts or hazards.
Keywords	Capsule, nub-e, specification, workshop, questionnaires, chemical firebreak, PYRO, Preventive Intervention Means (Capsules)
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ABBREVIATION / ACRONYM	DESCRIPTION
AAFF	Advanced Aerial Fire Fighting
AF3	Advanced Forest Fire Fighting Project
AFF	Advanced Fire Fighting
AGL	Above Ground Level
ICT	Information and Communication Technologies
FL	Flame Length
FM	Fuel model
GIS	Geographic Information Systems
GV	Ground Vehicle
N2000	Nature 2000
QFD	Quality Function Deployment
PYRO	PYRO FIRE EXTICTION S.L
RS	Rate of spread
SME	Small and Medium-sized Enterprises
UAV	Unmanned Aerial Vehicle.
WUI	Wildland Urban Interface

5. EXECUTIVE SUMMARY

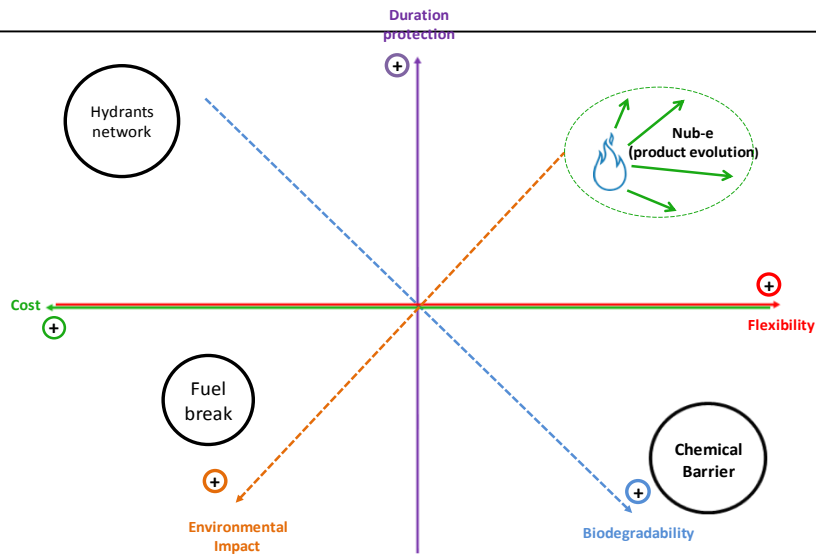
In the last few years, the large-scale forest fires have increased their importance due to several factors such as the expansion of wildland urban interface (WUI), poor landscape and forest management and arson fires. These so-called “Mega-fires” are constituted by interacting simultaneous fires with extreme fire behavior across a large geographic area, they usually cross ownership boundaries and involve different jurisdictions and urbanized areas. Therefore, they are particularly destructive and difficult to control with the technologies and systems currently available to fire fighters and emergency agencies.

Faced with this challenge, European Commission through the Framework Programme Seventh, in the “Security research theme”, funds the Project called Advanced Forest Fire Fighting (AF3), “preparedness for and management of large scale forest fires”. It intends to provide an extraordinary improvement to the efficiency of current fire-fighting operations and to the protection of human lives, the environment and property by developing innovative technologies and means to ensure a high level of integration between existing and new systems.

To reach this objective, AF3 project focuses on innovative active and passive countermeasures, early detection and monitoring, integrated crisis management and advanced public information channels.

The present report is provided as a result of the work carried out in WP7.4 Preventive Intervention Means (Capsules), within the framework of AF3 Project. The main objective of WP7.4 is to design Preventive layers based on multiple capsule subsystems placement allowing the protection of wildland-urban-interfaces and wildland critical infrastructures without the removal of vegetation.

The development of capsule preventive layers will bring a completely innovative passive countermeasure for forest firefighting, combining the effect of instantaneous solutions like chemical firebreaks with the extended duration of dedicated infrastructures, which require from a significant amount of investment and planning to be effective. These capsules, known as Nub-e, will introduce a new approach in the management of Forest Fire emergencies, providing efficiency, extended duration, flexibility and environmental respect in a sector where solutions employed up to date provide opportunity for innovation.



This document is based on information covered in design briefing for system specifications, and the information relating to the chemical and hazardous properties of materials in use.

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1. INTRODUCTION

The AF3 project involves trials with fire fighting media based on deployment of capsules containing fire fighting media which includes chemical compounds.

2. BACKGROUND

PYRO FIRE EXTINGUISHMENT S.L. (**PYRO**) is a Spanish SME that is part of the AF3 Consortium. AF3 (Advanced Forest Fire Fighting) is a large integration project aimed to the development of a complete system capable to efficiently react in all fire management scenarios and conditions to protect and safe human lives, environment and property. AF3 Project understands this system as the combination of efficient single sub-systems with a high level of integration and focuses on the following areas to reach its objectives:

- Innovative active countermeasures
- Innovative passive countermeasures (prevention measures)
- Early detection and monitoring
- Integrated crisis management

PYRO participation in AF3 consists of the development of the only innovative passive countermeasures integrating in AF3. In AF3, PYRO's goal is to design, develop and deliver one of these sub-systems, a preventive capsules' layer, which will act as a passive countermeasure within AF3 system.

This system of preventive layers is known as "Nub-e". **Nub-e** has been conceived as a protective barrier that can be rapidly deployed. These barriers are composed of capsules containing a fire retardant agent which is automatically released when a fire is detected. Capsules' operation is completely autonomous, and does not require from the intervention means personal, allowing fire brigades to focus on fire control activities, gaining thus productivity in firefighting.

PYRO is leader of WP7.4 Preventive Intervention Means (Capsules) in AF3, and also participates in other WPs and activities within AF3 providing their expertise and knowledge on Forest Fires operations and market.

PYRO has worked with POLITO in the definition of user requirements (WP2), FHG in the analysis of security of passive countermeasures (WP4), ELBIT SYSTEMS in the development of innovative countermeasures (WP7), and the rest of the partners in different tasks.

The role of the present document is to cover the first stage of the work carried out in WP7.4, extracting the conclusions extracted from the performing of the WP different activities (technical, research, development, market analysis) in the first eight months of the project.

The Fire Fighting systems under review will deposit water, potentially chemical substances and small amounts of plastic polymers on the target site. Some aspects of this deposit may have detrimental effects. In that respect, potential environmental effects will be required to characterise any negative potential and to fully inform any user authority prior to their deployment.

3 OBJECTIVES

The objective of this document is to present the properties of chemicals which have been incorporated in capsules used within the project and which may potentially be used in fire prevention and fire fighting in future. Included are observations about the materials of construction of the capsules themselves.

This document has also the objective to make PYRO's work visible for AF3 partners in order to improve coordination with dependent activities (WP4.1, WP4.3, WP7.1, among others) , as well as to make understandable to the EC-REA, and the interested public, the work performed in this WP. The information provided is primarily from Material Safety Data Sheets (MSDSs) from the chemical suppliers.

This will allow any trials within the AF3 project to be carried out safely with acceptable impact on persons and the environment.

4. Structure of the report and Description of the Process:

The following information is already recorded in the Capsule Specification Report already provided by PYRO:

- **The Work Method:**
- **Current Wildfire Situation..**
- **Preventive layers state of the art:**
- **Users and technical requirements:**
- **Description of Nub-e system:**
- **Quality Function Deployment (QFD):**
- **Conclusions:**

and is not repeated in this report.

4.1. Description of the process:

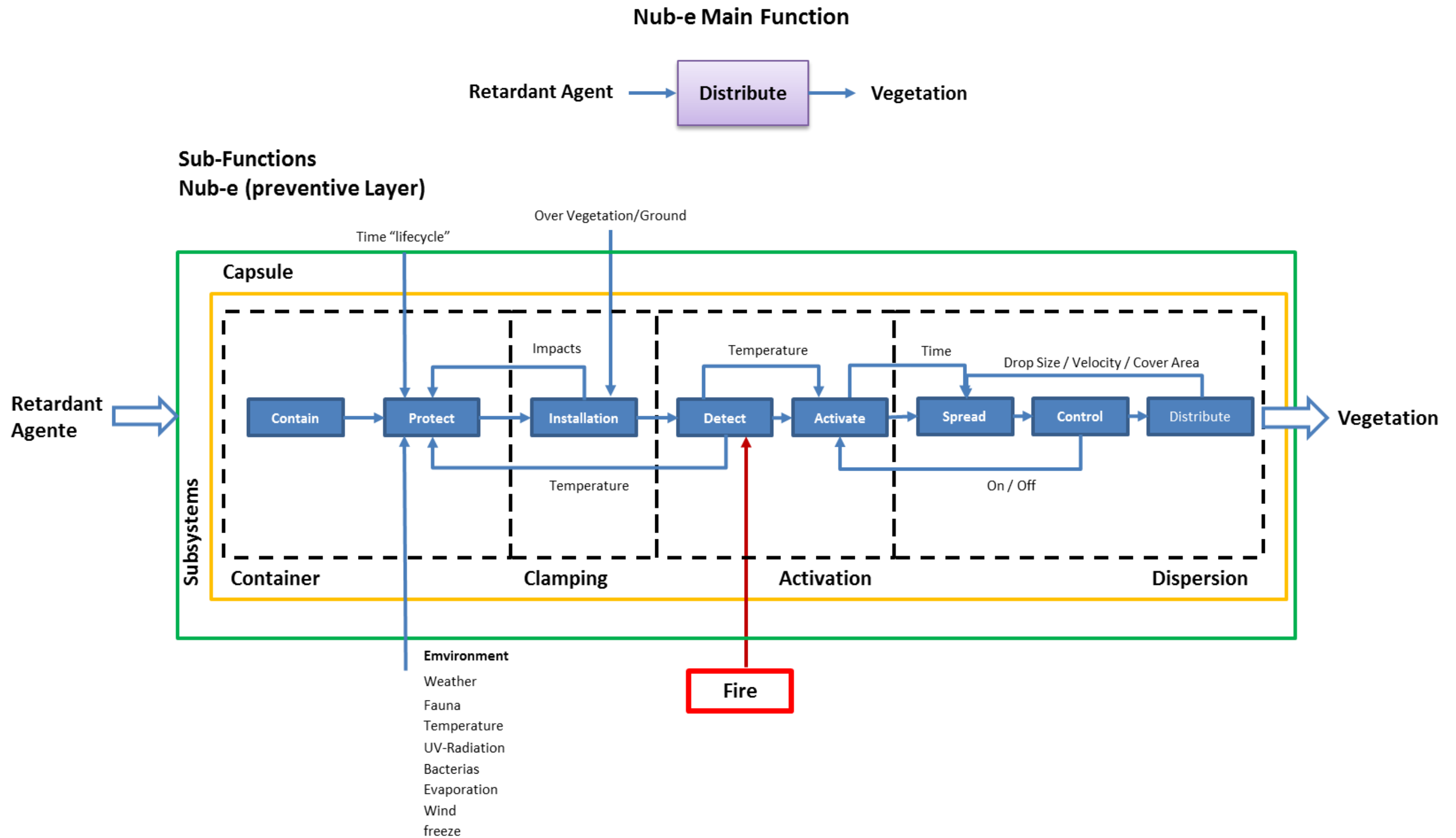


Figure 1. Functional description of a Nub-e capsule

4.2. RELEVANT INFORMATION ON CONTAINER MATERIALS:

This system has to perform two sub functions “**contain**” and “**protect**” the extinguishing agent during its full product lifecycle. Container main requirements are to allow Nub-e functionality after its installation, protecting it from environment action, UV radiation, animals, temperature changes, wind strikes, etc.

The main subsystem factors are material selection within the existing polymers range. At the design stage, a biodegradable or hydro soluble polymer has been discarded since no rapid prototyping techniques are allowed on them. Geometry is envisaged as the critical design conditioning, being useful volume, storage, transport and installation important restraints as well.

5. Chemicals Data

5.1. Material Safety Data Sheets (review of Data)

Ref 4 PYRO provided Material Safety Data Sheets for Capsule contents:

Product Name	Composition	Comment on Environmental effect and animal exposure	Provided by	Manufacturer	CLP concerns?
Fireade 2000	None given (proprietary)	Standard statements on low environmental impact	PYRO	Fire Service Plus inc.	NO
Fireade 2000 Climate Control	None given (proprietary)	Standard statements on low environmental impact	PYRO	Fire Service Plus inc.	NO
FR CROS 134 T	< 10% 2-amino-2-methylpropanol. Otherwise inerts	Standard statements on low environmental impact. Bio degradable.	PYRO	Budenheim	NO
FR CROS 134 P	Ammonium Polyphosphate	Standard statements on low environmental impact – Slight fish toxicity	PYRO	Budenheim	NO
FIRESOR B MO	Sodium Acrylate/Acrylamid copolymer	Standard statements on low environmental impact – Slight fish toxicity. Eye irritant. Bio degradable..	PYRO	EVONIK	NO – eye irritation to be noted.
SOLBERG 3150A	Di Ethylene Glycol, Acryl Sulphate, Sodium Alkyl Sulphate, Surfactants	No data, but compounds known to be low toxicity in environment. Further data will be requested from PYRO	PYRO	Solberg Asia Pacific.	To be assessed with further information.

5.1 BIODEGRADABILITY - UNIT PERCENT [%]

It is to be capable of being decomposed by biological agents or process.

The objective is that all the subsystems that form Nub-e can be completely biodegradable (100% biodegradable), although it is very complicated, especially in this first stage of tests and essays.

However, the aim is that if a capsule is installed and it is ever activated by a fire, when it stays in the forest longer than its useful life it disappears on its own, with no environmental impact. In fact, PYRO is working to achieve the material, when it degrades in air, it release product to contribute to conserve the vegetation such us ecological fertiliser.

Attached to this report:

- **Material Safety Data Sheets:**

6. Conclusions:

The following are considered:

- Evaluation of chemical persistence or bio degrade-ability of firefighting substances and any plastics used to contain these.
- Effects on ground water
- Ecological effects on receptor watercourses (rivers, streams lakes)
- Effect on drinking water sources
- Direct effects on animals which may graze on treated areas
- Potential for contamination of animal species tissue which may be enter the human food chain. (farming, fishing or hunting)
- Potential bio-accumulation in species coming into contact with firefighting or fire retardant materials.
- Products of combustion of any containers and chemical compounds used in firefighting (e.g. pellet 'bag' and any chemical fire retardants)
- Consideration of possible effects at the final use of timber (construction, combustion, paper etc.)

In all cases there is sufficient outline information in the MSDSs to indicate acceptable impacts in all categories considered. In practice it may be possible that a user may incorporate chemicals not covered by the list above. In such cases, it is the user's responsibility to meet local safety and environmental requirements.

7. References:

Ref 1. REACH and Safety Data Sheets: This describes basic environmental the necessary information for w Material Safety Data Sheets.

<http://www.hse.gov.uk/reach/resources/reachsds.pdf>

Ref 2 European Directive 67/548/EEC. Classification labelling and packaging of dangerous substances;

<https://osha.europa.eu/en/legislation/directives/exposure-to-chemical-agents-and-chemical-safety/osh-related-aspects/58>