LIFE-TRIALKYL

un processo chimico altamente innovativo e sostenibile

LIFE14/ENV/IT/000346

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With the contribution of the LIFE Programme of the European Union under grant agreement LIFE14/ENV/IT/000346

COMMERCIAL IMPLICATION

- **EU and Global Registration of the new technology:** restart EU production of sustainable Trialkylphosphites, today all imported from Far East (the sustainability gain through this approach follows the ECHA SEA guidelines 2017)

- EU **leadership** regain in the segment to serve EU and extra EU Enterprises

- **New partnerships** with downstream sectors within:
  - Plastic Industry
  - Lubricant Industry
  - Agrochemistry

- **Co-development** within the circular economy concept with the agrofood industry starting from EU to Global

EXPECTED IMPACT

SOCIO ECONOMIC IMPACT: PLASTICS

- **Generation of a social care chemical industrial product.**
  - Phenol free trialkylphosphites used mainly in the plastic industry (PVC stabilizers), The industry is slowly moving toward the use of cleaner stabilizers and a production in EU of this raw material can help a faster shift toward phenol free products.
  - avoiding 160.000 t/yr globally of harmful chemicals and at least 786t/yr related to Italmatch chemicals' consumption
  - VOCs < 5ppm
- **Enhancement of the Circular Economy in the Chemical Industry**

EXPECTED IMPACT

SOCIO ECONOMIC IMPACT: Agrochemistry

- **Generation of a social care chemical industrial product**
  - Production of insecticides that acts as acetylcholinesterase inhibitors to control insects in a wide range of crops. Production of insecticides in EU consumes around 1500 MT/y of imported, from outside EU, trialkylphosphite.
  - Inclusion of NH_4Cl secondary product for agro applications in the Circular economy concept
- **Enhancement of the multiple waters strategy by making the industrial water reusable in agriculture**
  - WATER AND ENVIRONMENT implications: SEC(2007) 993
  - WATER, EMISSIONS AND ENVIRONMENT implications: the EU2020 Flagship initiative Sustainable Growth
  - WASTES MANAGEMENT AND ENVIRONMENT: The COM(2005) 666 (to give origing to Waste Framework Directive 2008/98/EC)

EXPECTED IMPACT

SOCIO ECONOMIC IMPACT: LUBRICANTS

- **Generation of a social care chemical industrial product.**
  - Easier synthesis of lubricant additives acting as friction modifiers used is several applications.
  - Reducing energy (fuel) consumption of the machines lubricated with said additives

- **Enhancement of the Circular Economy in the Chemical Industry**

EXPECTED IMPACT

SOCIO ECONOMIC IMPACT: OTHER INDUSTRIES

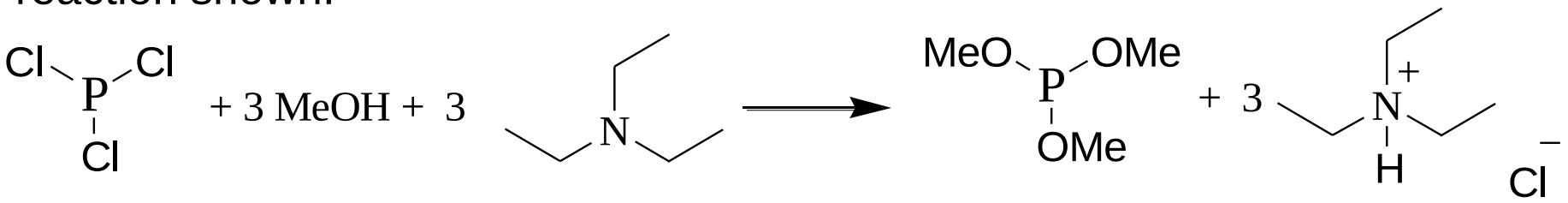
- **Generation of a social care chemical industrial product.**
  - Easier and more economic synthesis of API (active Pharma Intermediates) using this type of molecules as primary raw materials.

The benefits of LIFE-trialkyl-state of the art

1) PCl3 + alcohol + tertiary amines process

One of the two technologies implemented in the EU and worldwide

For example, the TMPi production process, using methanol, follows the reaction shown:



- Wastewater: 4 l/kg of product (NaCl aq)
- Use of toxic substances: 4 kg of dichloromethane/kg of product, 1 kg of NaOH /kg of product, 2,5 Kg of triethyl amine or 2 Kg methymidazole.

The benefits of LIFE-trialkyl-state of the art

2) The second technology implemented in the EU and worldwide: transesterification
Triphenyl phosphite is reacted with alcohols, to yield trialkyl phosphites and phenol

$$PCl_3 + 3\ HOC_6H_5 \rightarrow P(OC_6H_5)_3 + 3\ HCl$$
$$P(OC_6H_5)_3 + 3\ MeOH \rightarrow P(OMe)_3 + 3\ HOC_6H_5$$

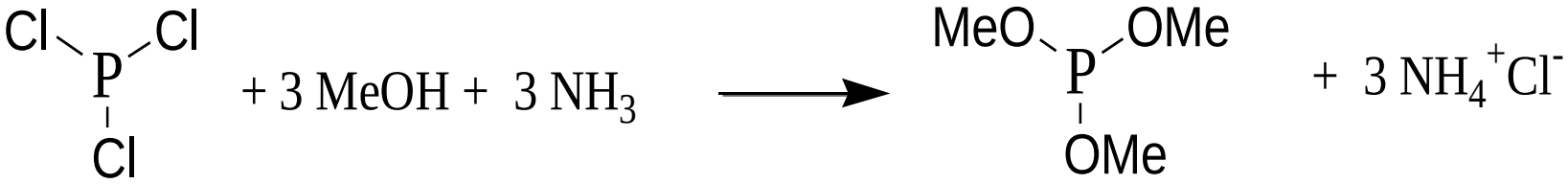
The transesterification process thus involves the use of phenols derivatives (triphenyl phosphite), which **are harmful for the human health (sub-chronic toxicity to the skin, allergic reactions, irritation to the respiratory tract, neurotoxic) and the environment (suspected mutagenic)** [2014, ECHA database; EPA database; 2005, D. Sasseville et al., Dermatitis 16(2); 1974, A. Hamilton, et al., Publishing Sciences Group, Inc., 1974., p. 315].

- Wastewater: none
- Use of toxic substances: 2,6 kg of triphenyl phosphite/kg of product, 0,8 kg of PHENOL /kg of product

The benefits of LIFE-trialkyl

The LIFE TRIALKYL project will demonstrate an innovative TriAlkylPhosphite (TAPi) production process characterised by the use of simple precursors, i.e. PCl3, ammonia and alcohol. The resulting products will consist of high quality TAPi (at least 95% purity) and triammonium chloride as a by-product.

Example of TMPi synthesis reaction process



- Wastewater: NONE.
- By product: 1,3 kg of ammonium chloride / kg of Product.

Challenges of LIFE-trialkyl

Process optimisation is critical;

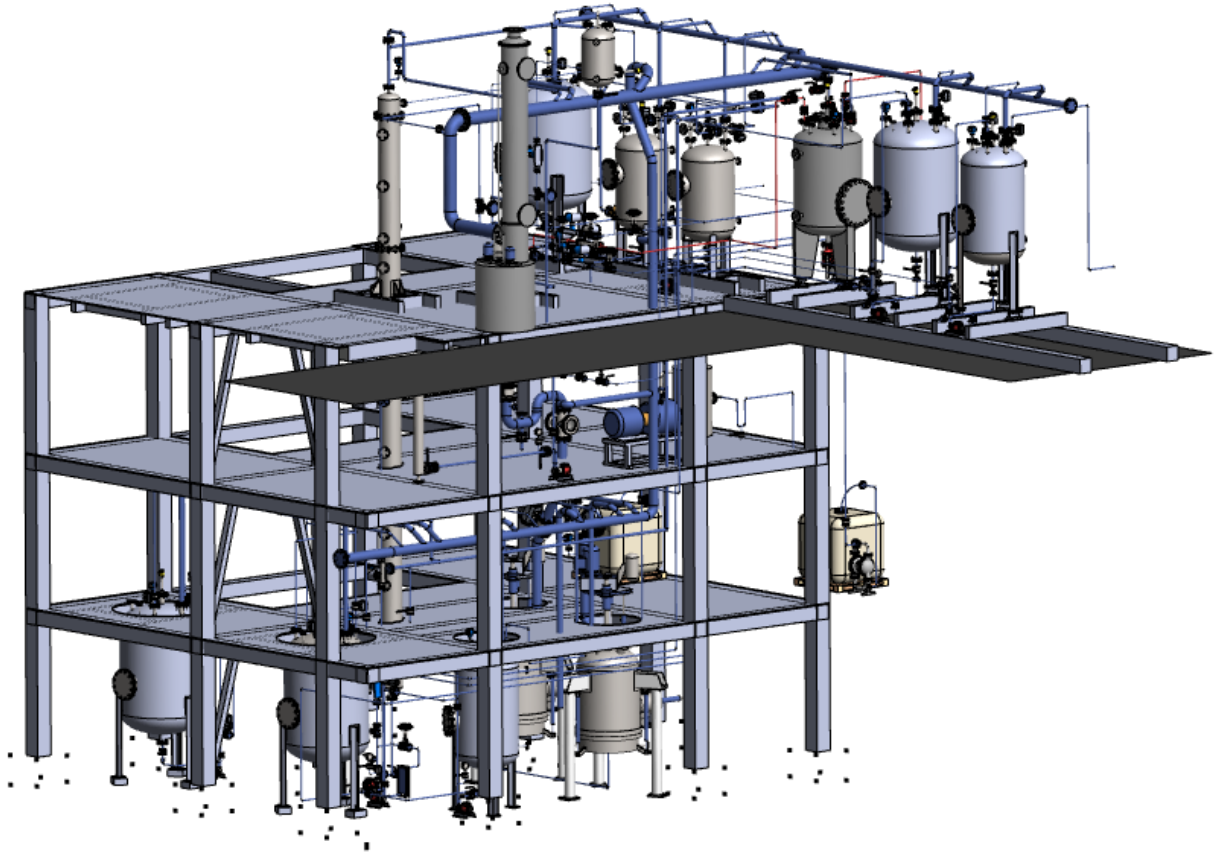
Definition of
- solvent usage (if necessary at all),
- reaction temperature,
- Correct contact time in a continuous process

…all to maximise product purity and to achieve a cost efficient, eco-friendly synthesis
Provisional TARGETS for LIFE_trialkyl project

	Trimethyl phosphite	Triethyl phosphite	Tributyl phosphite
Appearance	Clear liquid	Clear liquid	Clear liquid
Colour (Apha)	Max 50 apha	Max 50 apha	Max 50 apha
TAN (expected typical value + target)	<1 ; target 0.5 max	<2; target 0.5 max	<2; target 0.5 max
GC purity target	>95%	>95%	>90%

Phase B1 - Pilot realization

Development of the arrangement of the pilot plant



Resolving various constraints:

- Safety requests
- Regulations and requests of the institutional entities
- Operations requirements
- Maintenance optimitazion
- Budget restrictions

Phase B1 - Pilot realization

Development of the arrangement of the pilot plant

The Pilot Plant has started to run during Q4 2018 and after the first set of trials (10) and continuous improvements is now starting to give consistent results.

We expect to be able to have samples of desired quality of the first tri-Alkyl Phosphite available for customer testing by end of Q1 2019.

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European Commission

Thank you all very much for your attention and for your contributions!

Italmatch Chemicals

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Italmatch Chemicals

Sviluppo chimica spa

RISE