Pilot Plant in Spain

Local challenges regarding waste management

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FUNDACIÓN GLOBAL NATURE

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Project co-financed by the European Regional Development Fund

Waste management challenges in Spain – focus on pig farming sector

For this project focused on pig slurry, because:

- Spain is the 4th pork producer in the World, 2nd in EU (19% of the volume produced, 21% animals) and accounts for 14% of the total agricultural production in Spain
- Intense production model (+90%) => continuous decrease in the nb of farms, higher stock density, progressive increase of productivity, closed-cycle fattening
- Despite being a growing sector and the regulations, the main environmental challenges remain unsolved
  - nitrates pollution (diffuse pollution, eutrophication, soil pollution)
  - GHG emissions
  - Odours
  - Heavy metals dispersion (Cu, Zn)

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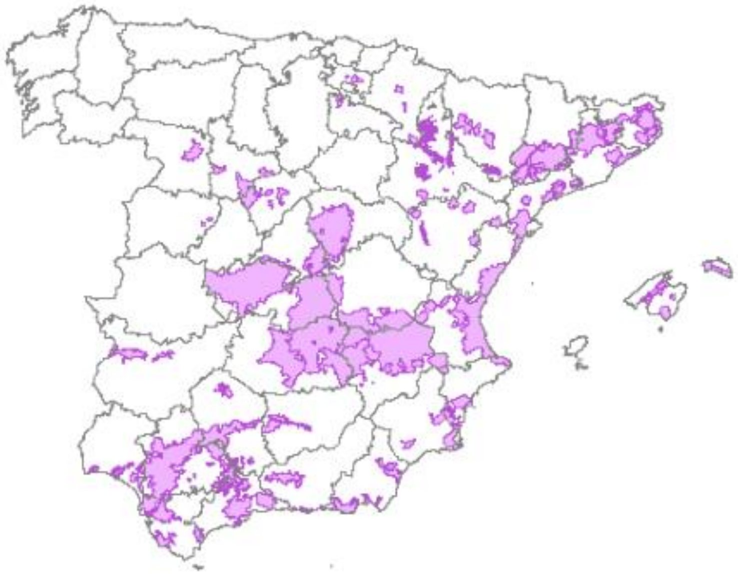
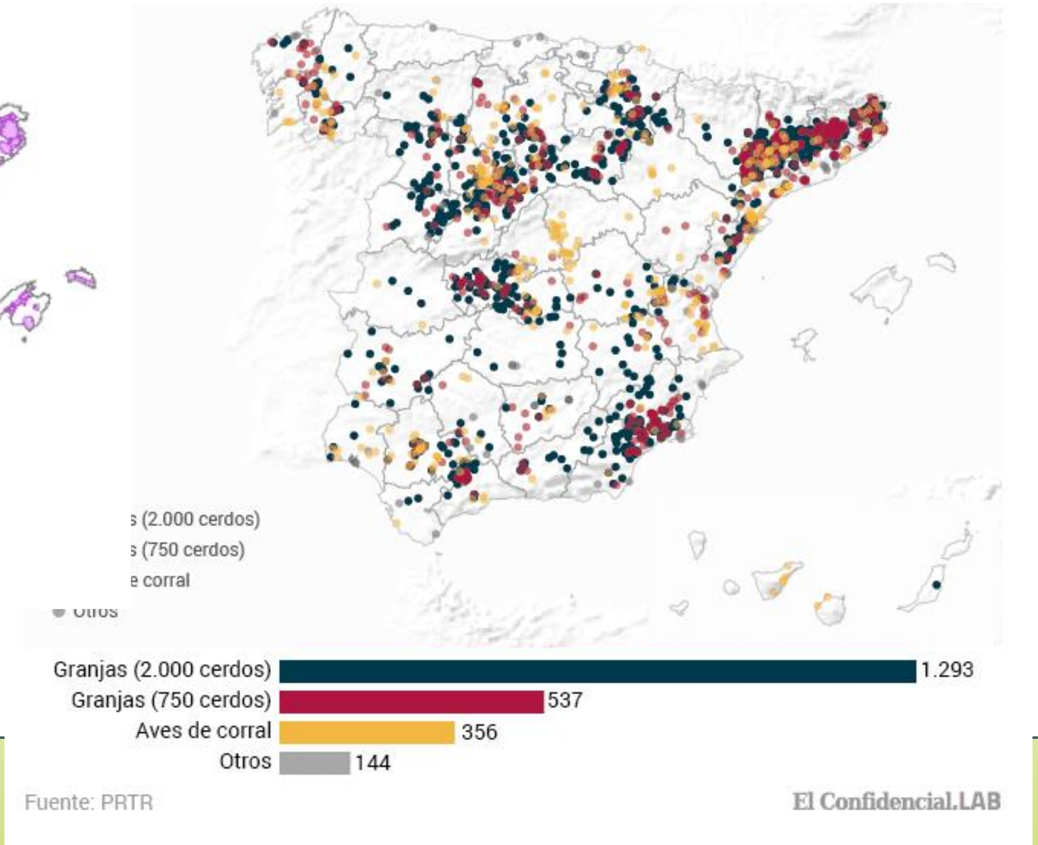
Waste management challenges in Spain – focus on pig farming sector

Nitrate Vulnerables areas



Location of pig farms (blue and red)



Nitrate vulnerable areas in pilot plant area

Local objectives (aligned with those included in the proposal)

- Explore a **waste management solution** that would benefit:
  - the pig farming sector: faces obligations but with few realistic and feasible solutions
  - the local authorities: need better compliance of current regulations
  - the citizenship: do not have to assume environmental impacts (e.g. nitrate pollution of drinking water, odours, etc.)

- Understand how struvite production can contribute to **reduce nitrate pollution problems**, more specifically:
  - How it should be adapted depending on the farm type
  - Explore the different value for money options
  - How it can be combined with other waste management technologies

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The process, main milestones

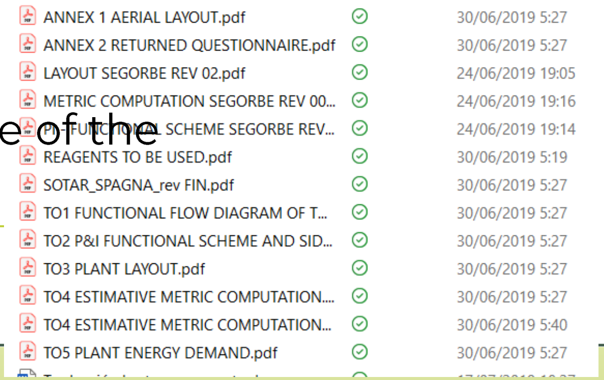
Agreement with Regional authority for reusing already existing plant (first half 2019)

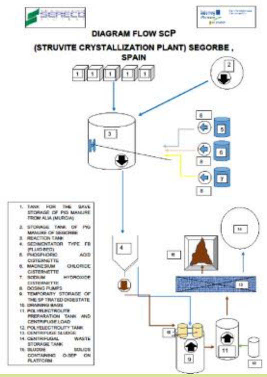
Internal discussion of pros and cons to work on private/public facilities

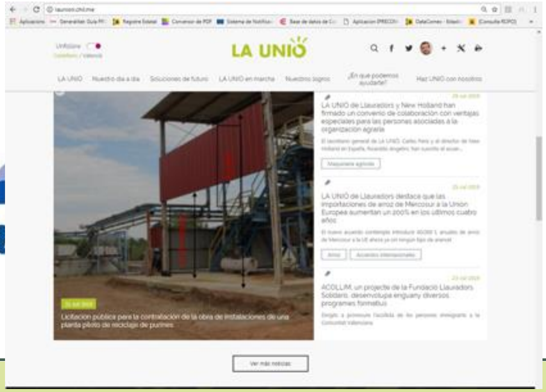
License for operating and works for adapting to legal requirements (June 2019)

Vegetation cleaning, concrete platform, update of main features...

Design of the plant, public tender and signature of the contract (September 2019)



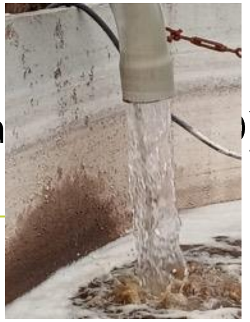




The process, main milestones


Plant construction (December 2019)

Internal discussion of pros and cons to work on private/public facilities



Testing, reagents purchase and reception of ALIA slurry (December-Ja)

Vegetation cleaning, concrete platform, update of main features…


Training session with Sereco and kick-off of the testings (January 2019)

The testing: phase 1 & phase 2

Why a testing in 2 phases?

Because it was the first time we were dealing with this technology and we needed more experience for operating the plant

Phase 1 => getting familiar with the plant, improve the process

Phase 2 => obtaining struvite using different approaches

Improvements done in phase 2

- New drying system
- Different slurry samples tested
- New and agreed protocol

Parameters	unity of measure	Methodology
pH		Standard Methods for Water&Wastewater 4500-H+-pH VALUE (2017)
TSS	mg/L	EPA 160.2;APHA 2540 D (TSS)
NH_4	mg/L	EPA 350.2; APHA 4500-NH3 B combined with APHA 4500-NH3 C;
Norg	mg/L	Standard Methods for Water&Wastewater 4500-N (2017)
COD	mg/L	APHA 5220; APHA 5220D
NO_3	mg/L	Standard Methods for Water&Wastewater 3500 NO_3 (2017), or APHA 4500-NO3 – E. or DIN 38405-9.
NO_2	mg/L	Standard Methods for Water&Wastewater 3500 NO_2 (2017); EPA 354.1, APHA 4500-NO2- B, and DIN EN 26777
Ca	mg/L	Standard Methods for Water&Wastewater 3500-Ca (2017) or: Microwave digestion (EPA 3051 and APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000, APHA 3111 and EPA 215.1
Mg	mg/L	Standard Methods for Water&Wastewater 3500 - Mg (2017); or Microwave digestion (EPA 3051 and APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or (AAS with EPA 7000, APHA 3111 and EPA Method 242.1)
K	mg/L	Standard Methods for Water&Wastewater 3500-K (2017) or Flame photometric APHA 3500-K or Microwave digestion (EPA 3051 and APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000 and APHA 3111
Na	mg/L	Standard Methods for Water&Wastewater 3500-Na (2017); Flame photometric APHA 3500-Na or Microwave digestion (EPA 3051 and APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000 and APHA 3111
PO_4	mg/L	EPA 9056A:2007; EPA 365.2+3, APHA 4500-P E/J, and ISO 6878
Cl	mg/L	Standard Methods for Water&Wastewater 5500-Cl- ; or APHA 4500-Cl– B or EPA 9056A or EPA 325.1 and APHA 4500-Cl- E.
SO_4	mg/L	EPA 9056A or EPA 375.4, and APHA 4500-SO_4^{2-} E and ASTM D516-16.
Arsenic	mg/L	Standard Methods for Water&Wastewater 3000-Metals- (2017), Microwave digestion (APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000, APHA 3111
Cadmium	mg/L	Microwave digestion (APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000, APHA 3111
Total Chromium	mg/L	Microwave digestion (APHA 3030 K) and ICP-AES (EPA 6010B and EPA 200.7) or ICP-MS (EPA 6020B and EPA 200.8) or AAS: EPA 7000, APHA 3111

analisi r&s tecnologie ambientali SERECO BIOTEST

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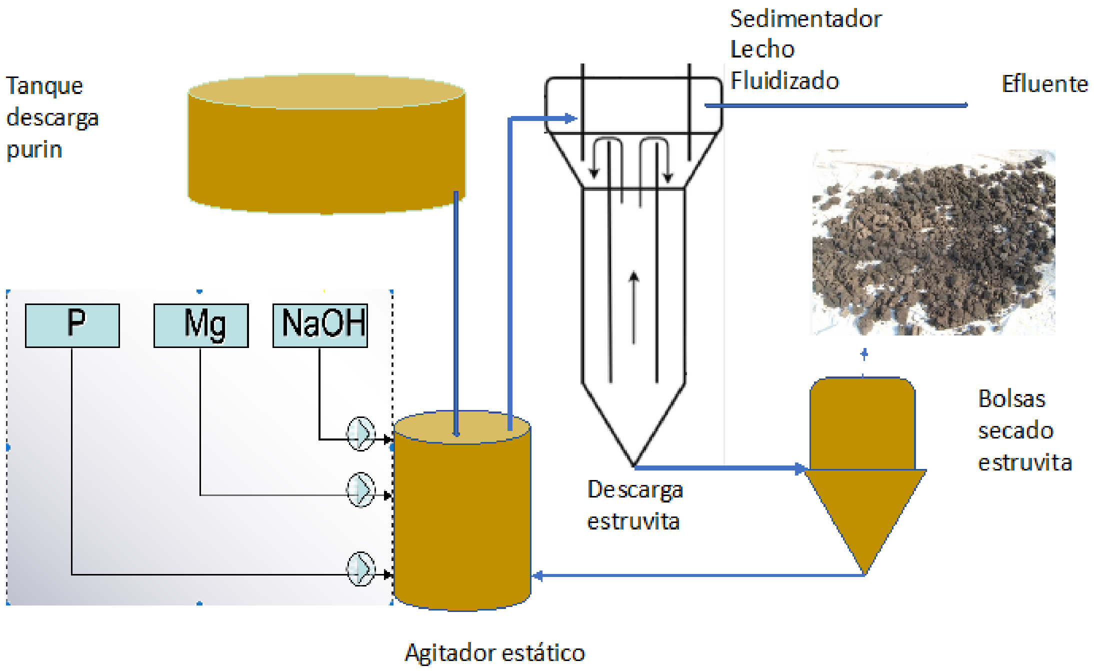
Project title and acronym	**RE-LIVE WASTE-** Improving innovation capacities of private and public actors for sustainable and profitable REcycling of LIVEstock WASTE
Work Package	WP-3
Activity n and title	3.8 – Technical training session
Deliverable n. and title	D382 – Training materials
Responsible Partner	Sereco Biotest
Participating partners	All partners
DOCUMENT TITLE	**METHODOLOGICAL PROTOCOL FOR THE SP TESTING CONTINUATION AT SEGORBE, REGION VALENCIANA**
Main authors	Roberto Poletti
Reviewers	Luca Poletti Alessandro Toccaceli Alessio Torzuoli Francesco Rinaldi Andrea Brugoni
Rev.	rev 04 / 18/06/2020

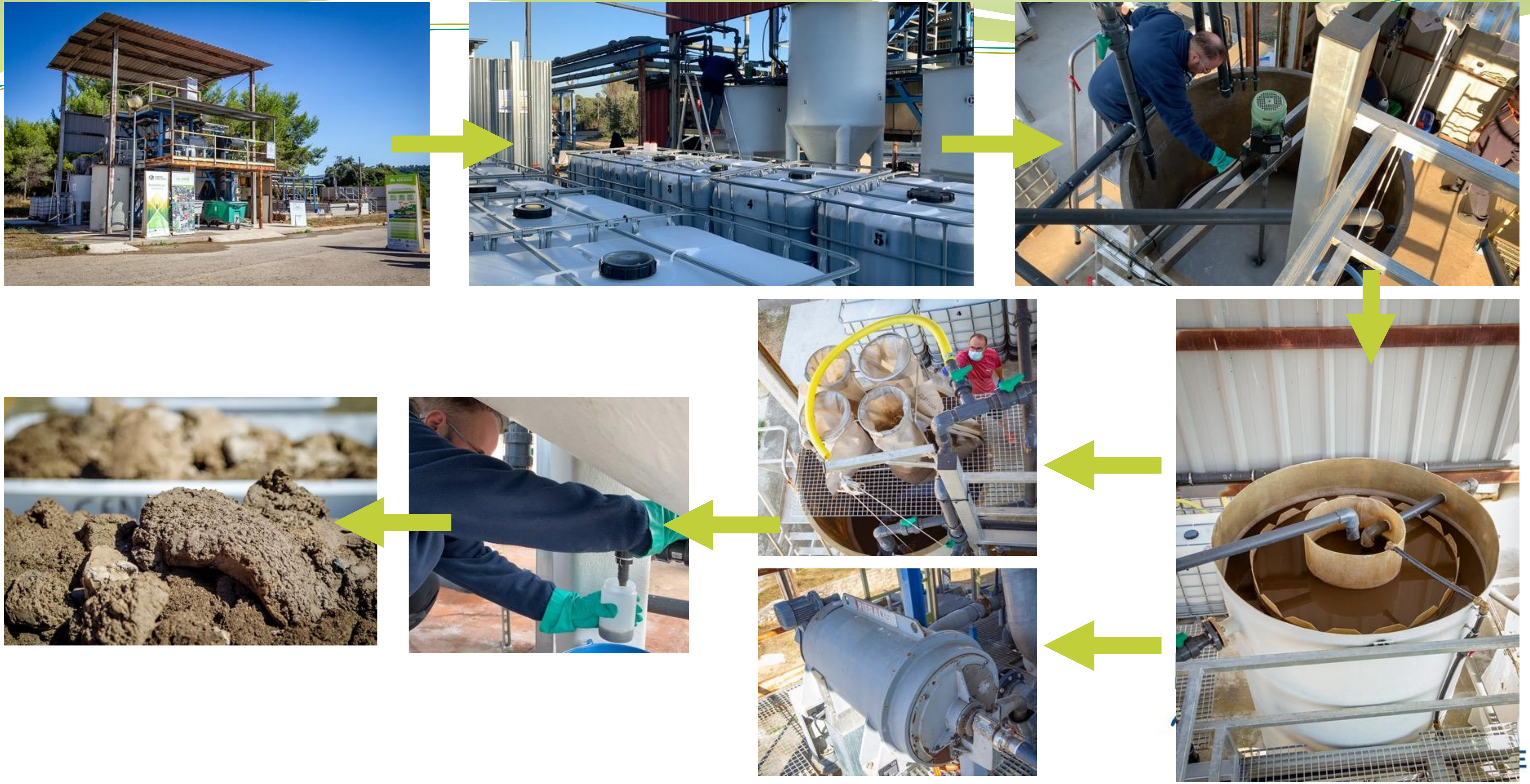
The testing: protocol and operations

1st: 1,4 litres of H_3PO_4, 17.2 Kg de MgO and 0 NaOH
2nd: 0,8 litres of H_3PO_4, 17.2 Kg de MgO and 0 NaOH
3rd: 2,0 litres of H_3PO_4, 17.2 Kg de MgO and 0 NaOH

Two different drying systems:
-Centrifugation
-Drying bags

TOTAL: 6 different SAMPLES





Results obtained: OSEP produced

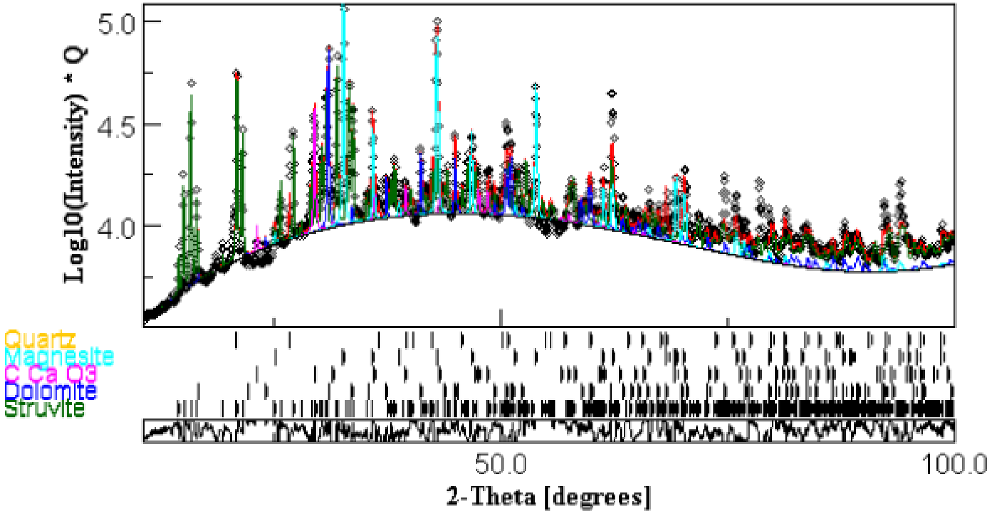
The batch selected for the analysis revealed:

- A purity of 50% in struvite, but small crystals
- Being compliant with *Salmonella*, *E. coli*, anaerobic sulphate reductive bacteria *and Ascaris* requirements
- Being compliant with contaminants (Cd, Cr, Cu, Ni, Pb, Zn) limits required by Regulation

Water content (at 40°C): 15,3%
Total Organic Carbon: 3,8%
Ammonium: 1,84%
Total Nitrogen: 1,69%
Phosphorus pentaoxide: 10,39%
Total K: 0,44%
Magnesium: 13,7%

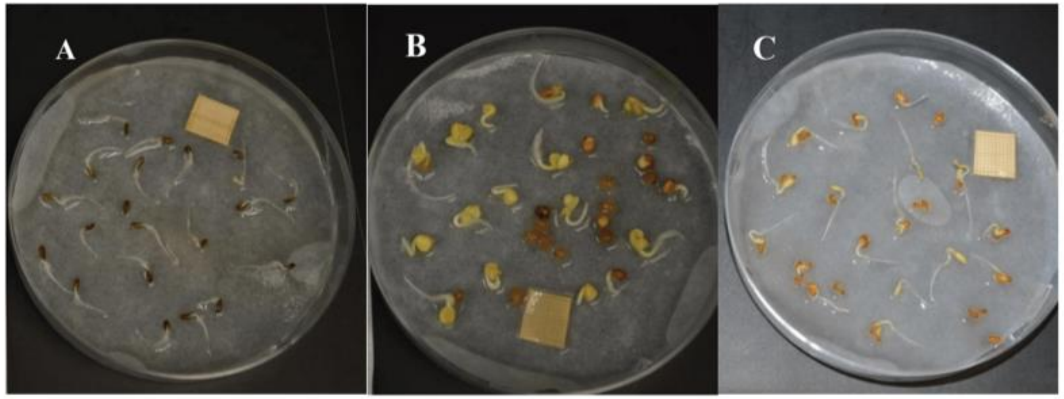
Phase	a (Å)	b (Å)	c (Å)	β (°)
Struvite (pure)	6.955	6.142	11.218	--

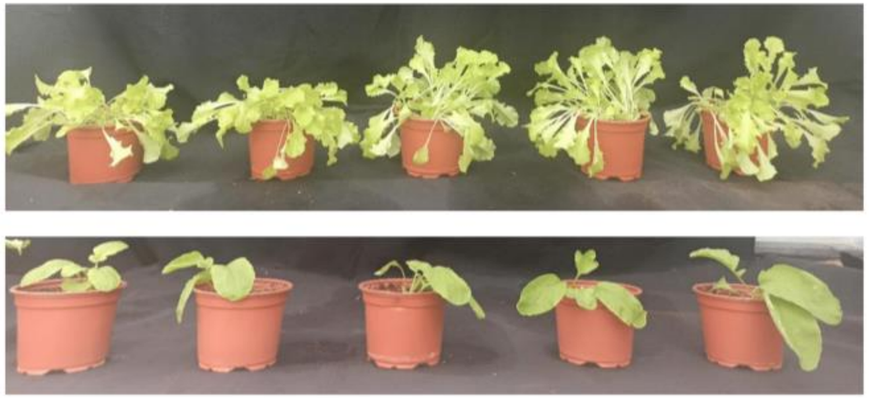
Phase	a (Å)	b (Å)	c (Å)	β (°)	Crystallite size (Å)	Microstrain	Quantitative (wt.%)
Struvite	6.9447	6.1395	11.2204	--	1730	1.01 E-3	50.0
Dolomite	4.8143	16.0167	-	-	1418	6.08 E-4	13
Calcium carbonate	4.9876	17.0575			1000	1.00 E-4	6.0
Magnesite	4.6442	15.0271			1827	8.50 E-4	30
Quartz	4.9258	5.3951			1885	5.35 E-4	<1 wt.%



Results obtained: agronomic and economic results

The agronomic protocol determines that the addition of struvite to plants under controlled conditions results in better conditions for plant growth (faster plant growth, higher levels of chlorophyll, better shelf life, igher concentration of phenols and flavonoids...)





The economic analysis revealed an acceptable economic feasibility, although with some figures that would be improved once the technology is more mature (investment for 50m^3 treatment plant 190k, yield 17 kgOSEP/m3, production cost 300€/t Investment Return Rate 10%)

Results obtained: expert exchange and transferring

More events than expected, with very high interest/acceptance (according to surveys)

- 1 workshop (July 2020)
- 3 Open Days (July and November 2020) + 1 Vir
- 1 Virtual Open Day
- Technical visits/online meetings

Materials specifically produced for the events: rc project dossier, movie, TV and radio…

Results obtained: expert exchange and transferring

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Results obtained: expert exchange and transferring

Main learnings from the pilot experience

- Struvite of medium purity (50%) was produced in the Spanish plant, it was free of pathogens

- The slurry management with the pilot plants meets some of the objectives, specifically reduce nutrient load, reduce volumes of waste managed by farmers, reduce odour, etc.

- The material obtained has agronomic advantages compared to inorganic fertilisers

- All this was obtained with a relatively low-cost approach (simpler technology, less expensive process, using when possible alternatives to pure reagents, etc.) in an attempt of reducing investment and operational costs

- Learnings were very useful for transferring and exchange with experts and policy-makers, and struvite production is not better positioned as a realistic solution in the mid term

Main learnings from the pilot experience

Investment in human capital is the basis for a society of innovation and knowledge