

**WETWINE – Innovations in the application of constructed wetlands at wineries****Summary**

The general objective of the WETWINE project is to test two wetland-based systems built for on-site treatment of wastewater (dregs) and treatment sludge, and their subsequent use on the vineyard itself (circular economy).

In the La Vinyeta winery, located in Mollet de Peralada, a pilot demonstration system was installed in which the wastewater line combined a hydrolytic (HUSB) digester and a horizontal subsurface flow (HSSF) constructed wetland, with the aim of ensuring purified water of sufficient quality for its discharge into public waterways or reuse for irrigation. For the sludge line, a sludge drying reed bed (SDRB) was used, allowing sludge from the digester, once dehydrated and stabilised, to be incorporated into the soil as a fertiliser for the vineyards.

A pilot plant was installed in the Raimat winery, located in Raimat and part of the Codorniu group, to check the effect of innovative management of a sludge dewatering system using a constructed wetland (SDRB). The system was conventionally designed, but the innovative management of the sludge feed sought to optimise the surface area required to achieve stabilisation, in order to reduce required investment costs. The results obtained in this pilot project have been applied to establish the design and cost of an SDRB system to treat all sludge generated in the biological activated sludge plant at the Codorniu winery in Sant Sadurní d'Anoia.

**Objectives****A) Objectives of La Vinyeta:**

- HUSB digester: Verify digester efficiency in suspended solid retention at different hydraulic retention times (HRT). Two different HRTs were tested to assess the adaptability of an HUSB anaerobic digester of a given volume (4 m<sup>3</sup>) to the different flows generated in the winery throughout the year, without reducing efficiency.
- Check the correct operation and sizing of the system that includes all the elements, as well as its efficiency:
  - o Water line: HUSB digester + HSSF constructed wetland
  - o Sludge line: SDRB to treat sludge from the HUSB digester

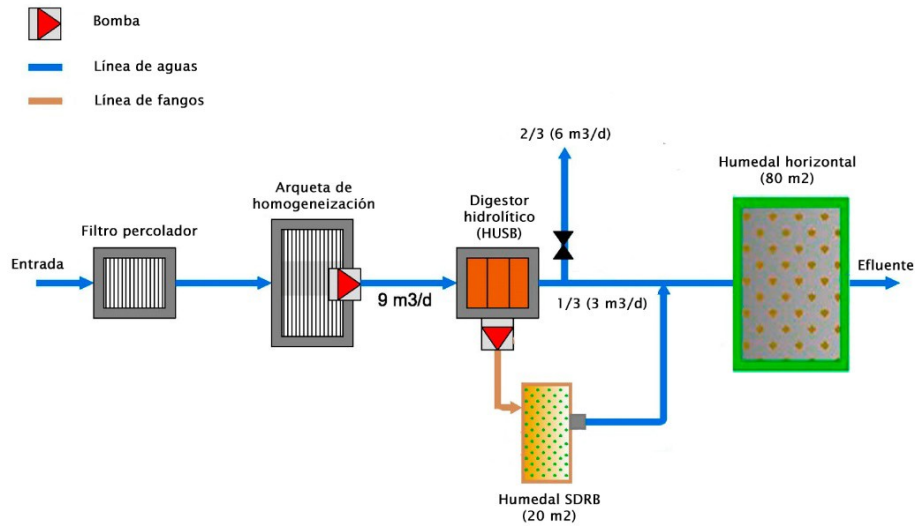
**B) Objectives in Raimat (Codorniu):**

- Management of a conventional sludge dewatering system using an SDRB providing more sludge than in conventional feed. This would provide the same degree of stabilisation with less surface area, lowering investment costs.
- Check whether the sludge stabilisation rate from a biological winery WWTP is different from that observed with sludge from an urban WWTP.
- Estimate the design and costs for an SDRB for CODORNIU, establishing the return on investment compared to current sludge management, which consists of dewatering with a centrifuge and subsequent external management at a composting plant 150 km away.

Description of the actions carried out in the project

A) La Vinyeta:

The following elements were installed in La Vinyeta as the pilot system for the winery's wastewater (dregs) treatment:



A commissioning period was necessary, by which time a 3-point analytical plan had already been carried out: HUSB digester input and output and the HSSF wetland output to assess change in system efficiency.

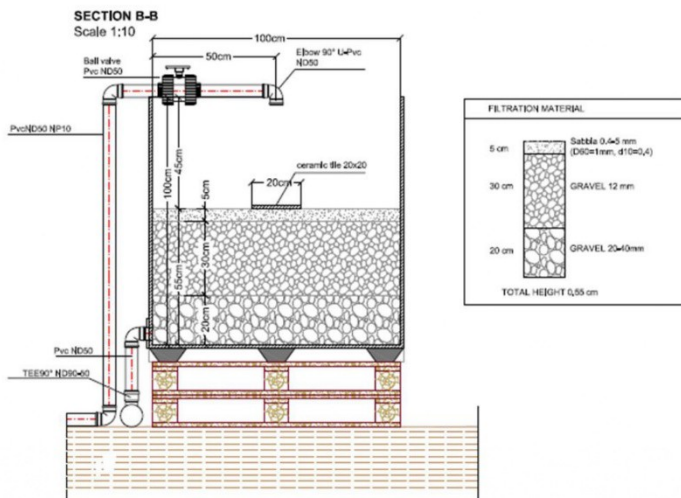
*\*lavinyeta*

**WETWINE**



**B) Raimat (Codorniu):**

In Raimat, an SDRB was reproduced in eight 1-m<sup>3</sup> containers. In four of them, so-called ‘classic’ sludge feeds were applied and in the other four, experimental feeds were applied, initially at triple the volume, although this was later reduced to double:



8 cubiconainers:

- 4 tractament clàssic
- 4 tractament experimental

Superfície de SDRB = 1 m<sup>2</sup>



4 x SDRB experimental  
(6 càrregues al dia)

4 x SDRB clàssic  
(2 càrregues al dia)

3 dies de càrrega/ 15-30 dies de repòs

## Final results and practical recommendations

### A) La Vinyeta:

The system correctly integrates all the elements. The HUSB digester is able to retain much of the suspended solids and adequately compensate for variations in the wastewater flow from the winery, while maintaining adequate efficiency with the two HRTs tested. The degradation of part of the organic matter in the HUSB digester and the subsequent elimination of contaminants in the HSSF wetland allow an effluent to be obtained whose quality is sufficient for discharge or reuse in irrigation, however it still requires development to obtain maximum efficiency. The sludge dewatering system is sized for the potential volume of sludge generated by the HUSB digester.

The costs and dimensions of a final plant that treats the entire volume of wastewater generated in this winery (about 9 m<sup>3</sup>/d) are estimated as follows:

Design flow	9	m <sup>3</sup> /d
HSSF wetland	240	m <sup>2</sup>
SDRB	20	m <sup>2</sup>
Investment cost	60,000	€
Operational and maintenance costs	1,500	€/year

### B) Raimat (Codorniu)

A feed in the system of experimental containers with a triple flow to the feed in the 'classic' system (33 kgTS m<sup>-2</sup> to<sup>-1</sup> vs 11 kgTS m<sup>-2</sup> to<sup>-1</sup>) causes clogging problems in these four pilot wetlands. But if it is reduced to double flow (20 kgTS m<sup>-2</sup> to<sup>-1</sup>), the wetland then works perfectly.

The stabilisation rate for sludge from the biological WWTP treating wastewater from the winery was found to be similar to that observed for sludge from urban WWTPs.

Both fresh and treated sludge meet the limits set out in *Annex I B of Royal Decree 1310/1990: Limits of heavy metals in sludge intended for agricultural use*, regardless of soil pH.

The design and costs of the final plant to treat sludge from the CODORNIU biological plant are estimated at:

Sludge production in the thickener (ST = 3%)	1,350	m <sup>3</sup> /year
Clean surface of the SDRB (8 units)	800	m <sup>2</sup>
Investment cost	108,000	€
Operational and maintenance costs	5,000	€/year
Return on investment	5	years

## Conclusions

### A) La Vinyeta

The system proposed by La Vinyeta is suitable for the treatment of wastewater generated by the winery and its subsequent use for irrigation or discharge into the waterways; however, this can only be confirmed once it reaches maximum efficiency. The sludge generated in the HUSB digester is treated in the wetland system by sludge dewatering, which dewateres and stabilises it sufficiently for application as fertiliser for the vineyards. This provides comprehensive on-site treatment of effluent and its use in the vineyard itself (circular economy).

The combination proposed in the project, anaerobic digester + constructed wetland, consumes 3% of energy compared to the activated sludge system (*Source: Hoffmann et al. (2012)*) or less, as it makes use of gravity flows. Nor does it require the addition of chemicals.

### B) Raimat (Codorniu):

A definitive plant consisting of an SDRB for the Codorniu winery (Sant Sadurní d'Anoia) would allow on-site management of the activated sludge from its biological treatment plant, with a return on investment of 5 years, obtaining a stabilised sludge that can be applied as fertiliser to vineyards. A feed with an average value of 20 kgTS m<sup>-2</sup> to<sup>-1</sup> for the commissioning phase, and 40-50 kgTS m<sup>-2</sup> to<sup>-1</sup> as a design load is recommended.

This sludge dewatering system generates 70% less CO<sub>2</sub> emissions than centrifugal treatment (*Source: Steen Nielsen (Orbicon, DK)*), and does not require the addition of reagents (coagulant or polyelectrolyte). As for comparative life-cycle analysis (LCA), it has an impact between 1,000 and 6,000 times lower than other more common systems: centrifuge and transport to a municipal WWTP (*Source: Uggetti et al. (2012)*)

## Leader of the Operational Group

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**Subject area(s) of application**

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|-------------------------------------|---|
| <input type="checkbox"/>            | Agricultural production system                                |
| <input type="checkbox"/>            | Agricultural practice   |
| <input type="checkbox"/>            | Agricultural equipment and machinery                          |
| <input type="checkbox"/>            | Livestock farming and animal welfare                          |
| <input type="checkbox"/>            | Vegetable production and horticulture                         |
| <input type="checkbox"/>            | Landscape / Territorial management                            |
| <input type="checkbox"/>            | Pest and disease control                                      |
| <input type="checkbox"/>            | Fertilisation and nutrient management                         |
| <input type="checkbox"/>            | Soil management   |
| <input type="checkbox"/>            | Genetic resources   |
| <input type="checkbox"/>            | Forestry  |
| <input checked="" type="checkbox"/> | Water management  |
| <input type="checkbox"/>            | Climate and Climate Change                                    |
| <input type="checkbox"/>            | Energy management   |
| <input checked="" type="checkbox"/> | Waste and by-product management                               |
| <input type="checkbox"/>            | Biodiversity and environmental management                     |
| <input type="checkbox"/>            | Food quality/processing and nutrition                         |
| <input type="checkbox"/>            | Supply chain, marketing and consumption                       |
| <input type="checkbox"/>            | Competitiveness and agricultural and forestry diversification |
| <input type="checkbox"/>            | General   |

**Geographical area(s) of application**

PROVINCE(S)	REGION(S)
Girona	Alt Empordà
Lleida	Segrià

**Dissemination of the project (publications, seminars, multimedia, etc.)**

INNOVI website -<https://www.innovi.cat/wetwine/>  
 CRDO Empordà website, published in December 2018 -<https://bit.ly/3kC3AOj>  
 ARLALORA website -<http://ecoetica.es/wetwine/>  
 IRTA Web -<https://www.irta.cat/ca/el-projecte-wetwine-construeix-aiguamolls-per-tractar-les-aigues-residuals-from-winerries/>  
 Facebook of La Vinyeta, publication from February 2019 -<https://bit.ly/2H6ZArj>

**More information on the project**

PROJECT DATES	TOTAL BUDGET
Start date (month-year): June 2018	Total budget: €100,015.50
Completion date (month-year): September 2020	DARP funding: €40,874.04
Current status: Executed	EU funding: €30,834.80
	Own funding: €28,306.66

## With funding from:

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*Order ARP/133/2017 of 21 June, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Association for Innovation operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups, and Resolution ARP/1868/2017, of 20 June, announcing the call for the grant.*



Generalitat de Catalunya  
**Departament d'Agricultura,  
Ramaderia, Pesca i Alimentació**



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