ULTIMATE

WATER SMART INDUSTRIAL SYMBIOSIS

Factsheet:

Subcritical Water Extraction

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The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869318

Subcritical Water Extraction

Unique points:

- ✓ Green Technology
- ✓ No use of organic solvents
- ✓ No residual organic solvents in the extract
- ✓ Faster Extraction Time

Overview of the technology

Subcritical Water Extraction (SCWE) is a method that benefits from the solvent properties of subcritical water. i.e. water at temperatures above the boiling point i.e., elevated pressures in order to keep it in liquid state, as seen in the phase diagram below Figure 1, with a working range between 100-250°C and 100-200 bar.
The subcritical water extraction can also be applied directly on undried matrices.

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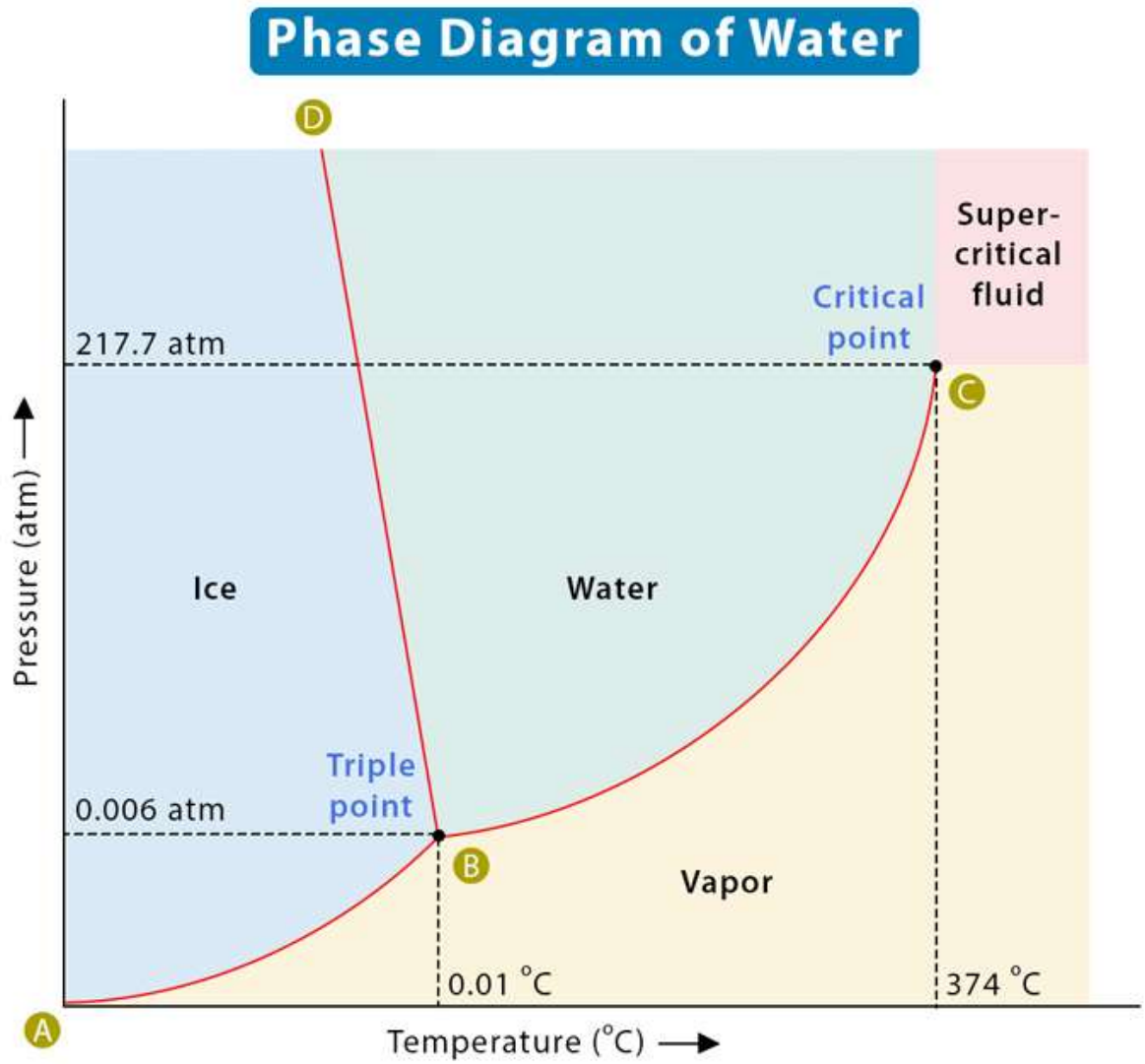

Figure 1 Phase diagram of water

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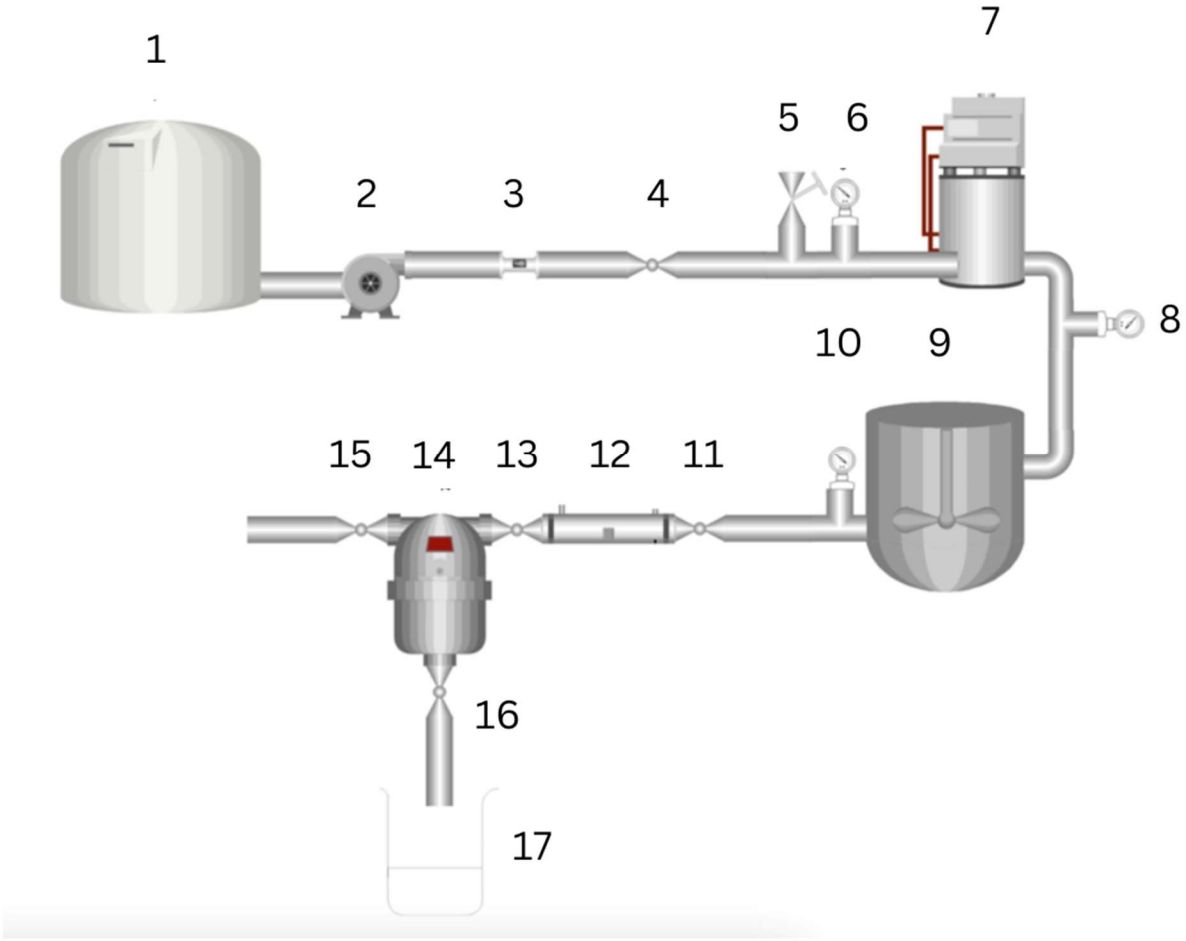

Figure 2 ***Scheme of a Subcritical Water Extraction System:*** ***1.*** *Water tank* ***2.*** *Pump* ***3.*** *Mass flow meter* ***4.*** *Valve* ***5.*** *Back-pressure regulator* ***6.*** *Pressure gauge* ***7.*** *Pre-heater* ***8.*** *Temperature gauge* ***9.*** *Heated extractor* ***10.*** *Temperature gauge* ***11.*** *Valve* ***12.*** *Condenser* ***13.*** *Valve* ***14.*** *Separator* ***15.*** *Valve* ***16.*** *Valve* ***17.*** *Collector*

Subcritical water extraction follows the same principles of the liquid extraction but the pressurized conditions diversify the properties of the water as a solvent (Castro-Puyana et al., 2013).

Flow scheme of the technology

In the framework of the ULTIMATE project, in the Case Study 4, Subcritical Water Extraction is applied to extract antioxidants (polyphenols) from fruit processing water by-product. The industrial by-product flows through a macroreticular, non-fuctionalised adsorbent resin where the polyphenols are adsorbed. These polyphenols are recovered by subcritical water extraction.

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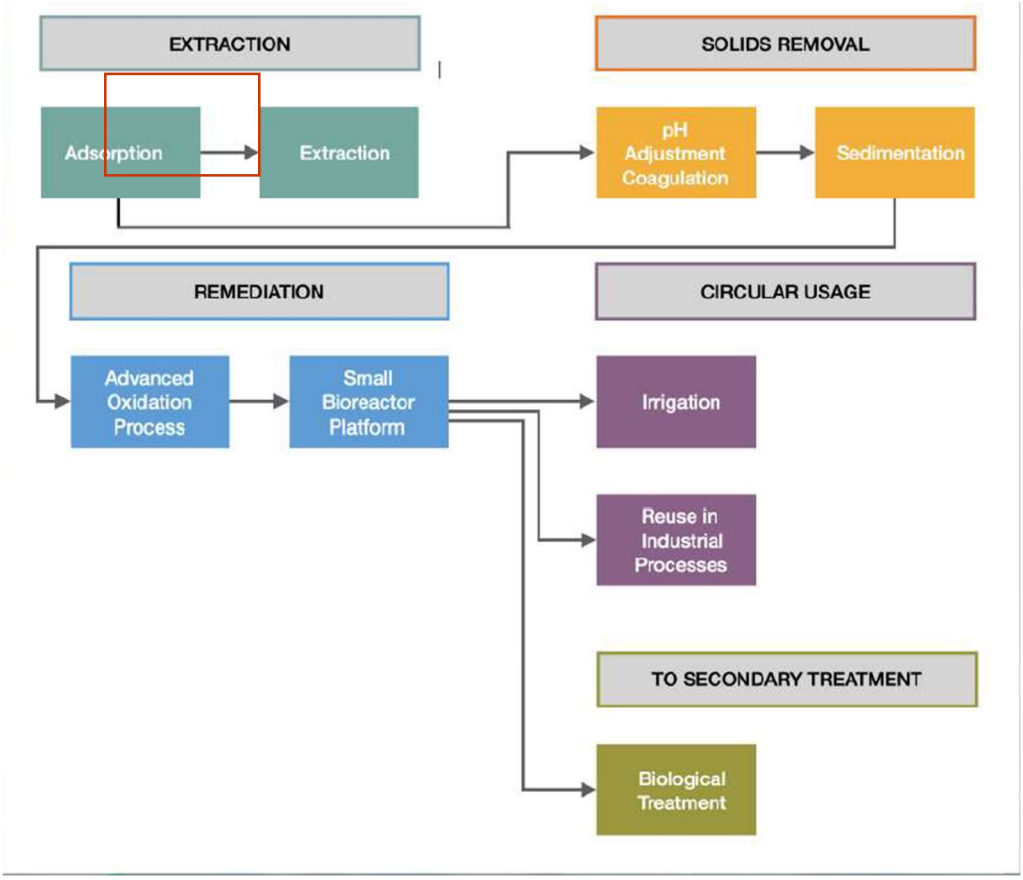

Figure 3 Flow diagram of the process

Pictures of the technology and product

Figure 4 Picture of the Subcritical Water Extractor

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Synergetic effects and motivation for the implementation of the technology

- ✓ ***Green Technology***

Subcritical Water Extraction reduces or even eliminates the use of organic solvents thus it be categorized as a green environmentally friendly method.

- ✓ ***Quality of the extract***

A major advantage of the elimination of organic solvents is that the final product/extract is free of organic residues thus it is of higher quality and safer for consumption.

Key performance indicators

Links to related topics and similar reference projects

Process/technologies	Reference
Antioxidants from winery waste	(Aliakbarian et al., 2012)
Extraction of polyphenols from lotus seed pop	(Yan et al., 2020)
Olive polyphenols extraction	(Xynos et al., 2012)

References

Aliakbarian, B., Fathi, A., Perego, P., & Dehghani, F. (2012). Extraction of antioxidants from winery wastes using subcritical water. *The Journal of Supercritical Fluids*, *65*, 18–24. https://doi.org/https://doi.org/10.1016/j.supflu.2012.02.022

Castro-Puyana, M., Herrero, M., Mendiola, J. A., & Ibáñez, E. (2013). 16 - Subcritical water extraction of bioactive components from algae. In H. B. T.-F. I. from A. for F. and N. Domínguez (Ed.), *Woodhead Publishing Series in Food Science, Technology and Nutrition* (pp. 534–560). Woodhead Publishing. https://doi.org/https://doi.org/10.1533/9780857098689.3.534

Xynos, N., Papaefstathiou, G., Psychis, M., Argyropoulou, A., Aligiannis, N., & Skaltsounis, A.-L. (2012). Development of a green extraction procedure with super/subcritical fluids to produce extracts enriched in oleuropein from olive leaves. *The Journal of Supercritical Fluids*, *67*, 89–93. https://doi.org/https://doi.org/10.1016/j.supflu.2012.03.014

Yan, Z., Zhang, H., Dzah, C. S., Zhang, J., Diao, C., Ma, H., & Duan, Y. (2020). Subcritical water extraction, identification, antioxidant and antiproliferative activity of polyphenols from lotus seedpod. *Separation and Purification Technology*, *236*, 116217. https://doi.org/https://doi.org/10.1016/j.seppur.2019.116217

Zakaria, S. M., & Kamal, S. M. M. (2016). Subcritical Water Extraction of Bioactive Compounds from Plants and Algae: Applications in Pharmaceutical and Food Ingredients. *Food Engineering Reviews*, *8*(1), 23–34. https://doi.org/10.1007/s12393-015-9119-x

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Outlook

Case study specific information will be provided, when the results of the other work packages are available:

- **Lessons learned from the case study**
- **Outcome of the assessments**
- **Legal and regulatory information concerning the whole value chain concerning the technology**
- **Business opportunities**

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