RESOURCE RECOVERY IN INDUSTRIAL PROCESSES. THE CASE OF THE CERAMIC SECTOR. IWAYS PROJECT

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The iWAYs project's main objective is resource recovery from the air emissions associated with different industrial processes in the chemical, steel, and ceramic sectors. Specifically, it seeks to condense the emissions released into the atmosphere in the form of vapours in order to recover their water and energy content. It is also sought to recover other materials present in these emissions. Recovering such materials can improve process sustainability and hence reduce harmful emissions into the environment.

The technology being developed in the iWAYs project for water and energy recovery from gaseous streams is based on state-of-the-art heat exchange systems, specifically on a Heat Pipe Condensing Economiser (HPCE). The implementation of the HPCE system in different case studies is complemented by the application of integrated strategies for smart water use, including tertiary water treatments, such as membranes and catalytic nanofiltration reactors.

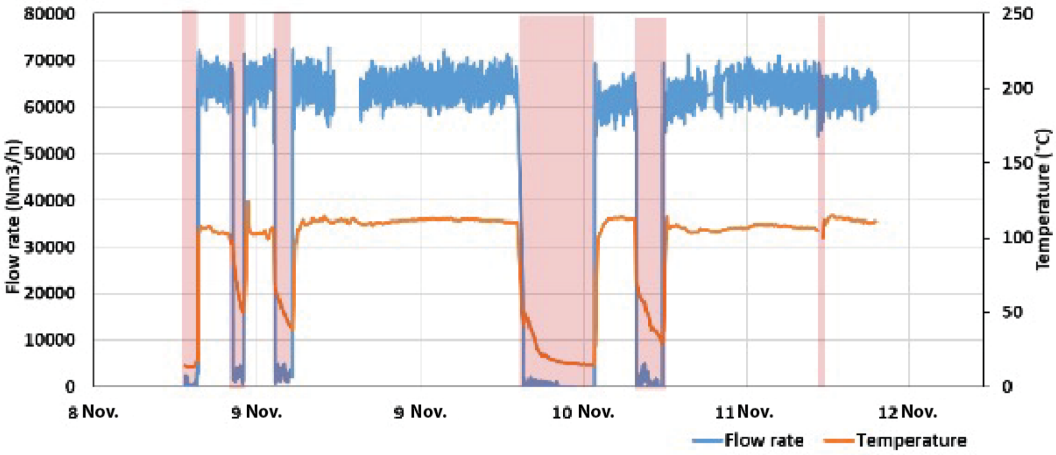
In the case of the ceramic industry, the project focuses on water and energy recovery from the streams generated in the spray-drying stage. The relevant streams have been studied and comprehensively characterized during the project, under discontinuous or semi-continuous conditions, by monitoring key parameters.

The challenges faced during monitoring include characterization of gaseous streams with high levels of humidity, temperatures close to the dew point, and a significant presence, in certain cases, of solid pollutants (particles), liquid pollutants (water droplets), and gaseous pollutants (of an acidic nature).

The results of some monitoring campaigns are shown in Figure 1 and Table 1. The presence of process shutdown periods, alternating with normal operating periods, can be observed. Under these conditions, the flow rate, temperature, and humidity of the stream remained stable. Parallel humidity measurements showed that the process was stable within narrow ranges of variation.

This information was used as the basis for the design and construction of the HPCE applied to the spray dryer.

Monitoring served to better understand gas stream behaviour and to identify the environmental control required to ensure appropriate process operation.



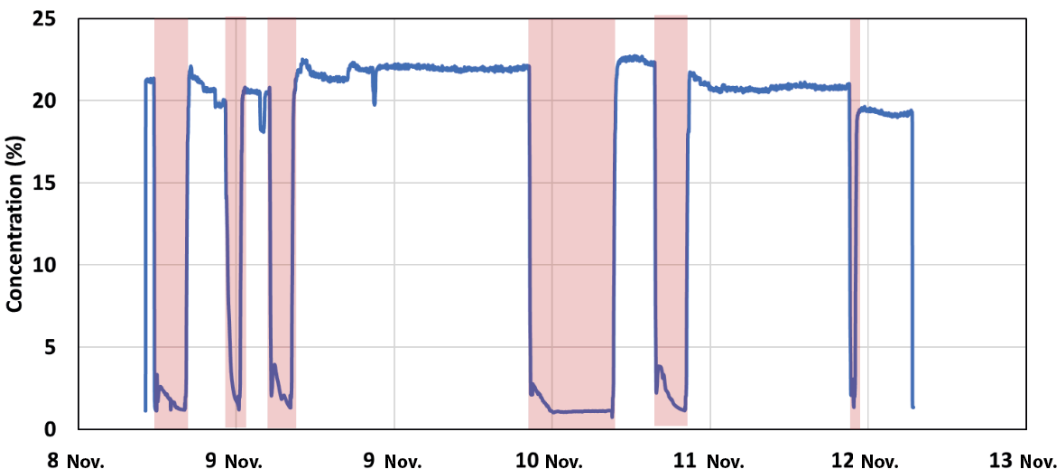


Figure 1. *Monitoring of the spray dryer (flow, temperature, and humidity)*

Sample	PM (mg/Nm^3)	H_2O (%)
M1 (09/11/2021)	7.6	19.1
M2 (09/11/2021)	7.2	18.0
M3 (10/11/2021)	8.7	19.4
M4 (10/11/2021)	8.9	19.6
M5 (11/11/2021)	6.9	18.2
M6 (11/11/2021)	6.9	18.2
M7 (11/11/2021)	5.8	17.7
M8 (12/11/2021)	6.7	16.8
M9 (12/11/2021)	7.1	16.8
Average	7.3	18.2

Table 1. *Gas stream characterization through extractive sampling*

A further task involved identification of all the relevant parameters that needed to be monitored online to ensure environmental protection associated with the recovery technology (HPCE) and collection of the information required to feed the decision-support system (DSS) developed in the project. Specifically, the control parameters included the gas and liquid stream flow rates and temperatures in order to assess the system's effectiveness in recovering energy and valuable resources such as water.

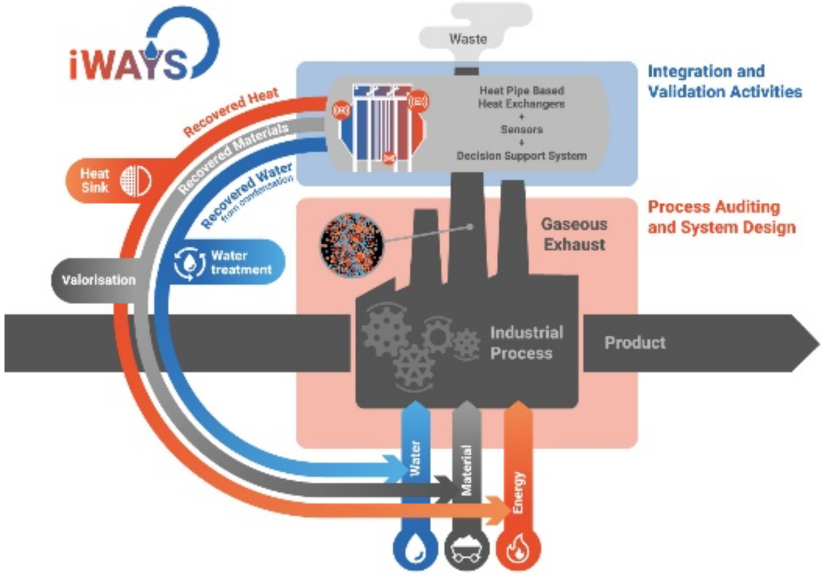


***Figure 2**. Concept map of the proposed iWAYs solution.*

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