Demonstration of an innovative method for the detoxification of pharmaceutical wastewater from pharmaceutical facilities

Deliverable C.1.3.: Sampling and analysis protocol to monitor the project environmental impact

ACTION C.1: Monitoring Protocol and Baseline monitoring

Coordinating Beneficiary

MEDOCHEMIE

PARTNERS

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Background

This report entitled: “Sampling and analysis protocol to monitor the project environmental impact”, was produced under co-finance of the European financial instrument for the Environment (LIFE programme) as the third Deliverable (C.1.3) of Action C.1 of Project “LIFE PHARMA-DETOX” (LIFE20 ENV/CY/000615) during the implementation of Activity C.1 on the “Monitoring Protocol and Baseline Monitoring of the project “.

This report presents an overview of the current ecological situation in the project’s target area. The target area is the sewage system of Limassol in which the 3 manufacturing plants falls into. The report’s results will be used as a reference to evaluate the prototype system’s impact on the ecological potential/status. The wastewater composition is provided and the analyzed parameters of the samples from the monitoring points are selected according to the requirements of the Water Framework Directive for a surface water body with "good status".

Acknowledgements

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Disclaimer

The information included herein is legal and true to the best possible knowledge of the authors, as it is the product of the utilization and synthesis of the referenced sources, for which the authors cannot be held accountable.

Note:

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Abbreviations and Acronyms

LIFE	LIFE Programme
Medochemie	Medochemie Ltd.
AU	Aarhus University
CUT	Cyprus University of Technology
NEVIS	NEVIS - NOVEL ENVIRONMENTAL SOLUTIONS S.A.
NTUA	National Technical University of Athens
UNICT	Università degli Studi di Catania
BOD_5	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solids
TN	Total Nitrogen
TP	Total Phosphorus
DO	Dissolved Oxygen

Executive Summary

Life PHARMA-DETOX project aims to detoxify wastewater from the pharmaceutical industry. The pharma-detox system will be able to treat the wastewater generated from production activities, ensuring that no APIs would end up in the wastewater sewage system without being processed and detoxified by the system developed.

This report entitled “Sampling and analysis protocol to monitor the environmental impact of the project” provides a description of the environmental impact of the project that is defined through the reduced energy consumption for wastewater treatment, reduced water consumption, avoided CO_2 emissions during prototype operation, and waste reduction. The environmental footprint of the system will be minimized using 100% renewable energy sources.

To make sure that LIFE PHARMA-DETOX objectives concerning its environmental impact are met, a multitude of different parameters are analyzed. Indicative physicochemical parameters to be analyzed within the scope of the project are temperature, pH, conductivity, total Nitrogen (TN), phosphorus, chloride, COD, BOD_5, and total suspended solids (TSS).

Careful and attentive implementation of the sampling and analysis protocols must be followed to achieve a representative overview of the process train pilot and its components as well as to access the environmental impact of the project.

1. Introduction

This report aims to provide information about the methodology to be followed for the selection and analysis of liquid samples of the innovative LIFE PHARMA-DETOX demo plant. The information presented in this report will provide input in Action B.2 “Construction and installation of the prototype LIFE PHARMA DETOX” to adjust and refine the design of the process train and in the conduction of the Life Cycle Analyses in the framework of Action C.3 “Monitoring the environmental impact of the project – Life Cycle Analysis (LCA) of the demo system”.

2. Selected Key Performance Indicators

The objective of C Action of the project is to monitor the impact of the project actions. A baseline monitoring must be carried out in order to capture the current status of the targeted area aiming to have a clear and representative picture of the area (C.1.2).

The major environmental problem addressed by the project is the continuous input of pharmaceuticals in the aquatic environment. Currently, wastewater from Medochemie's oral penicillins manufacturing facility (Limassol) ends up initially in the city's central sewage system and then in the wastewater treatment plant (WWST) of Limassol district (SBLA Plant). The aforementioned practice has been destructive to the ecosystems of the receiving water bodies, as well as resulted in water shortages that are harmful to both the environment and society. Environmental indicators were selected in Deliverable C.1.1 to quantify the improvement of the environmental efficiency of the pharmaceutical industry.

3. Environmental Indicators

In Deliverable C.1.1 selected the environmental indicators that aim at quantifying the improvement of the environmental efficiency of the pharmaceutical industry. The indicators selected refer to the change of energy consumption due to the full operation of the demo plant with renewable energy (solar), the reduction of water consumption, the reduction of waste, the avoided CO_2 emissions during prototype operation against the best practice applied in the sector and the enhancement of surface water quality at the area of the project implementation.

Reduction of greenhouse gas emissions (CO_2)

It is estimated that for the collection and the treatment of 1 m^3 of wastewater in a WWTP 1 KWh is needed. The PHARMA-DETOX system will treat 3650 m^3/year and will save 3650 KWh/year. In Cyprus the production of 1KWh release 0.810 Kg CO_2. As the demo system will work using 100% renewable energy (solar energy from the photovoltaic area) the reduction of CO_2 production will be about 3 tons/year. The replication of PharmaDetox system in the Netherlands will reduce the production of CO_2 by about 737 Kg CO_2/year.

Reduction of dangerous substances

The wastewater from the cleaning processes is the only part of the wastewater that is contaminated with APIs. The rest of the wastewater is the brine produced by the RO units

during the purification of water used in the production. All the APIs contained in this wastewater will be hydrogenated and transformed into non-toxic organic molecules during the wastewater treatment proposed. Thus, 5,220g of APIs/year will be detoxified by the PHARMA-DETOX system and will not be released into the urban wastewater. At the replication in the Netherlands the PHARMA-DETOX system will treat all the quantity of wastewater produced at about 2,5 m^3/day, 1,305 g APIs/year.

Wastewater (containing APIs) discharge at sewerage system is 10m^3/day equal to 3650 m^3/year. The PHARMA-DETOX system will have the capacity to treat approximately 10 m^3 of wastewater per day.

Wastewater reduction

Medochemie B produces ~70 m^3/d of wastewater. 10 m^3/d is the wastewater from the cleaning processes which is contaminated with APIs. The rest 60 m^3/d is the brine produced from the RO units that the company uses for the purification of water used in the production. The second is not contaminated with APIs. PHARMA-DETOX system will treat only the wastewater from the cleaning process. The reduction of production wastewater will be 14% and 100% of the wastewater from cleaning process. The replication of PharmaDetox system in the Netherlands will reduce the wastewater by about 100%.

Water reduction

The PHARMA-DETOX system will be able to recover approximately 3650 m^3 / year of clean water, 14% of the wastewater driven to the sewage system. The recovered water will be used for irrigation and cleaning purposes.

Energy reduction

The PHARMA-DETOX system will operate using 100% energy from renewable sources (solar energy). 10 m^3/d out of the 70m^3/d of wastewater produced will be treated by the proposed system. It is estimated that about 1 KWh is used from WWTP to treat 1m^3 of wastewater. Thus, as 3650 m^3/year will be treated and 3650 KWh/year will be saved as the system will use energy 100% from renewable sources.

The energy required for the whole wastewater treatment will reduce by about 14% and the energy required for the treatment of wastewater from cleaning processes will reduce by about 100%. Regarding replication in the Netherlands PHARMA-DETOX system will treat the whole

quantity of wastewater produced about 2,5 m^3/d, 910m^3/year. So, a 100% reduction of energy required is expected.

4. Conclusions

The indicators that express the environmental impact of the project will be evaluated on a regular basis., during the project implementation. These indicators are crucial to appraise the efficiency of the system as the aim of the project is to recycle and reuse water from WWTPs effluents, detoxification of APIs and minimize the environmental footprint.