www.medolico.com
www.facebook.com/medolico

MEDOLICO news

MEDITERRANEAN COOPERATION
IN THE TREATMENT AND VALORISATION
OF OLIVE MILL WASTEWATER

Newsletter #1/2013

MEDOLICO Project

The waste generated by the process of the extraction of olive oil needs to be disposed efficiently, not to be harmful for the environment: olive mills wastewater (OMW) has a low index of biodegradability and remarkable polluting properties.

Adequate processes and technologies need to be put in place to avoid pollution and to improve olive mills sustainability. These processes need to be efficient, easy, convenient and precursor of new possibilities with respect to the recovered products. Olive millers still do not use innovative methods in the OMW treatment basically because they are not aware either of the threats to local environment or the benefits they may get from an efficient usage of them, in terms of new market possibilities (energy market, cosmetics, phytotherapy, nutraceutics, etc.).

MEDOLICO geographical coverage

The aim of MEDOLICO Project is to inform olive millers of the environmental risk their activity generates and to provide them with innovative solutions to valorize OMW.

Along its three years' time duration, MEDOLICO Project works on the following main strands:

1) the compilation of a broad digest of OMW legislation in force and technologies available for the OMW valorization;
2) on-site pilot demonstrations to test/compare different processes;
3) evaluation of actual use of recovered water for either irrigation or recycling into olive oil processing operations;
4) feasibility and evaluation of OMW by-products recovery;
5) economic evaluation of the proposed solutions for OMW treatment and usage.

MEDOLICO's Results

Within the first set of project activities, partners have drafted a publication on **Olive mill wastewater management**. This deliverable contains valuable information on the following issues:

1. Analysis of OMW management existing status
2. Overview of legal framework
3. Technological benchmark
4. Potential valorization of OMW by-products

1. Analysis of OMW management existing status

The considerable variation in olive production schemes dictates management solutions which are closely linked to the type of wastes produced, the size of the olive mill, the regional distribution of mills, local enforcement of environmental laws and local conditions (e.g. hydrological sensitivity and proximity to potable water reservoirs and to composting facilities). Further increasing this variation is the lack of unified legislation in the major producing countries.

The 2nd and 3rd phase milling processes produce different wastes – a semi-solid waste and solid and liquid wastes, respectively. Moreover, OMW which is formed by the 3rd phase process is produced in relatively higher volumes per processed olive weight (Azbar et al., 2004).
Therefore, adjusted solutions are formed for each process. A centralized treatment plant is more suitable for areas with high density of mills and for large mills which can support the relatively high costs of establishing and maintaining such facilities. Large mills are also more regulated by local and national authorities and therefore, are keener in finding environmental acceptable solutions for their wastes.
In contrast, small and scattered mills confront relatively weaker regulation and enforcement and have fewer resources to support an engineered solution. Weak enforcement of environmental laws with the lack of a well-practiced cost efficient end solution, create the conditions for substantial illegal dumping to the environment and to local sewage systems which still occurs nowadays.
However, increasing awareness of the authorities to the substantial damages caused by illegal dumping put more and more pressure on mill owners to reach acceptable solutions within the local legal frame.

2. Overview of legal framework

1. The problem of OMW is further aggravated by the lack of a common policy among the olive oil producing countries. Every country, and even within countries every regional government, has its own legislation/regulations, and its own prioritizing of enforcement. All the above often vary greatly among countries and regions with a consequent non-uniform application of generally accepted guidelines. As olive oil production grows constantly both in the EU and in other countries, there is an urgent need for a unified set of strategies to deal with OMW among the olive producing states, which will also lead to better management, water saving and protection of the environment in all producing countries.
2. Similarly to the legislation issue, lack of coherent and unified enforcement policy in all major producing countries delays an environmental safe solution for the olive mill waste problem. Without constant and decisive enforcement, olive mill owners are reluctant from making the relatively high financial investment needed for treating their wastes.

3. Technological benchmark

The generation of OMW in the Mediterranean region has a significant environmental impact. Direct reuse of this wastewater in agriculture is limited by the phytotoxicity and antimicrobial effects due in particular to its high content in phenolic compounds, low pH and the presence of toxic fatty acids. The seasonal nature of olive oil production, the geographic dispersion of mills and economic limitations for cost effective treatment all present significant challenges in designing treatment options for OMW. Treatment of OMW is a complex problem that has not been satisfactorily resolved mainly due to socioeconomic and, to a lesser extent, technological reasons.

Several researchers have paid considerable attention in developing environmentally compatible and cost-effective treatment technologies capable of decontaminating what is considered to be a difficult and problematic waste. These technologies commonly comprise biological, physicochemical and advanced oxidation processes either alone or in various combinations. Both aerobic and anaerobic processes can be adopted for OMW treatment, even if anaerobic technology has clear advantages including lower excess sludge production (the quantity of produced excess sludge is 20 times lower than in aerobic process). Moreover, the anaerobic process produces biogas, a valuable by-product that can be used to fulfil the mill energy demand. However, with an aerobic follow-up treatment the mentioned advantages are enhanced, making this combined solution the preferred one for OMW treatment. On the other hand, due to high investment costs and complex process management, this technology is suited for industrial-scale oil mills or as a centralized treatment facility serving several oil mills. With regard to OMW treatment efficiency, the results of research available in the scientific literature suggest that AOPs are more efficient in removing a high percentage of organic content (about 90%) compared to other processes. Nevertheless, the intermediates formed during the various stages of oxidation may exhibit toxic behaviour thus rendering toxicity assessment as an indispensable task.

A single-stage biological or chemical treatment is unlikely to achieve complete mineralization at reasonable cost due to the complexity and heavy polluting load of OMW. On the other hand, a well-designed sequential treatment consisting of various chemical and biological processes with

well-defined treatment objectives may be the optimum solution. The need for such integrated treatments has been recognized recently and research efforts are being directed towards this approach.

4. Potential Valorization of OMW by-products

The review of literature and patents reported in this document shows the state of the art of polyphenols recovery from OMW.
Most of the work on OMW treatment aspects was up to now focused on the use and development of a single process, with the aim of OMW purification, and if possible, on recovery of treated water for agricultural purposes. However, many recent studies focused also on the extraction and purification of polyphenols from raw OMW and from OMW treatment by-products, such as concentrated liquid fraction obtained with membrane processes.
Consequently, today it is possible to easily treat OMW up to their complete re-use, disposing of a completely depurated water and of a concentrated solution rich in polyphenols.
Application of an appropriate OMW treatment technology allows obtaining a polyphenols rich fraction, which can be further concentrated. This effluent has got a high content of polyphenols (max 45-60 %), and high antioxidant properties. It can be applied in the cosmetic industry, the same as polyphenolic products obtained from other raw food processing by-products, such as tea leafs and grape seeds.
Up to now it is not possible to know an exact market price of the biophenols recovered from OMW by-products and separated up to a high purity grade. However, a rough estimation of the trade price in Italy made by Prof. Capannelli, who has been involved in polyphenols recovery research from many years, shows their value ranging from 40 to 80 € per kilo, depending on the purity grade. Moreover, the recovery of polyphenols rich concentrates during OMW treatment is interesting also from the point of view of quantity of OMW available for polyphenols extraction, since it was estimated that the value of concentrates obtained from a small /medium size olive mill is about 70.000 € per year.
It should be considered that polyphenols recovery implemented during OMW treatment process allows not only water recovery and recycle, but can also reduce OMW treatment costs. Regrettable, up to now, the approach of OMW treatment only for polyphenols recovery is not sustainable due to high investment and operational costs of the treatment plant and entrepreneurial risks.
According to the broad research, biophenols have demonstrated a high added value thanks to their positive actions in the prevention of tumors, and thus, in a pharmaceutical field. If further studies confirm that these molecules, if obtained at a very high purity rate, can be used as new products in medicines and as specific supplements, their economic advantages could be envisaged.

MEDOLICO Project aims to promote the purification and recycle or reuse of OMW. The project also seeks to obtain polyphenols rich concentrates, from which polyphenols can be extracted and purified, in order to make these precious molecules available for further studies for their application in the pharmaceutical field. Moreover, this process allows to depurate waters to make them compliant with legislative requirements and usable for irrigation purposes or for aquifers nourishment.

MEDOLICO News

- Partners will soon make available the comparative study on technologies for OMW treatment. **To be constantly updated follow us on www.facebook.com/medolico**

- Medolico project mentioned in "EU neighborhood Info Centre" website: http://www.enpicbcmed.eu/communication/turning-olive-oil-waste-euros-while-protecting-nature-feature-medolico

- Medolico Transnational workshop , Genova (Italy) – July 3rd, 2013 http://www.enpicbcmed.eu/communication/medolico-project-workshop-environmental-and-commercial-valorization-olive-mill-wastewa

Other Projects

In this section we provide information on other EU supported projects focusing on identifying sustainable solutions for water usages and consumption.

ENPI CBC MED Programme – Priority 2
Measure 2.1 – Prevention and reduction of risk factors for the environment and enhancement of natural common heritage

AQUAKNIGHT Project – Mediterranean water resources are extremely under stress, especially in the south and east shore. In Jordan, Lebanon and Tunisia, water demand constantly increases, while water use efficiency can still be considered as limited. These are the two most critical factors regarding the sustainability of the most elementary earth resource: water.
Under this concept, policies aiming at improving usage efficiency and at reduced losses and poor usage, are urgently needed. In this sense, AQUAKNIGHT project focuses on optimizing consumption and minimizing the Non-Revenue Water (water not metered or billed to consumers) through the implementation of five pilot projects in the cities of Limassol (Cyprus), Genoa (Italy), Alexandria (Egypt), Tunis (Tunisia) and Aqaba (Jordan).
For more information visit the website: www.aquaknight.eu

SWMED Project – The whole Mediterranean area is characterized by a strong need of new solutions able to provide and sanitations services while reducing water use and wastewater discharge. The SWMED project focuses on the optimisation the per capita water consumption at household and urban level through the implementation of water saving devices, reuse of treated wastewater, rainwater harvesting, a pool of technologies known as Sustainable Water Management (SWM).
For more information visit the website: www.swmed.eu

NANOWAT Project – Most of the Mediterranean countries suffer from water shortage due to both increasing demand and declining water quality. Rivers, lakes, groundwater resources and the sea have become more and more polluted by agrochemicals and other potentially toxic substances resulting from intense agricultural and industrial activities. Besides the necessary efforts to be undertaken to reduce water consumption, such a situation calls for innovative and cost-efficient solutions to purify contaminated water and recycle wastewater.

NANOWAT project focuses on the experimentation, development and diffusion in the Mediterranean area of new technologies for efficient water treatment based on natural and modified nano-materials, using either filtration and sedimentation, photo-degradation, or their combination. The application of nanotechnologies in the field of water treatment has the potential to offer low-cost and transportable solutions in areas where it is difficult or too expensive to implement large scale water purification plants.
For more information visit the website: www.nanowat.eu

"Promoting sustainable groundwater resources in the Mediterranean Basin" Project – Groundwater is the world's most important source of freshwater, constituting 97% of the earth's freshwater reserves. In many parts of the Mediterranean region, this resource is increasingly being polluted by human activities. Given the large role local authorities play in overseeing industrial and other polluting activities in their jurisdictions, these actors can considerably improve efforts to protect shared groundwater resources.
This project aims to empowering a selection of Mediterranean municipalities with the technical and administrative skills to alleviate sources of groundwater pollution in their jurisdiction as well as enhancing cooperation across Mediterranean Basin municipalities to protect common natural heritage.

LIFE + Programme – Environment Policy and Government
The 'aWARE' project aims to promote the re-use of reclaimed water within water management organizations. To this end, the project hopes to demonstrate the technical feasibility and economic and environmental advantages of two different technologies as advanced treatments for wastewater and reclamation facilities. The project proposes an innovative hybrid process using membrane bioreactors (MBR), powdered activated carbon (PAC) and nanofiltration (NF) to enable re-use of wastewater. It will experiment with MBR-PAC-NF configurations – including PAC dosage and cleaning conditions – to optimize their efficiency and reliability. It hopes to demonstrate the feasibility of such a process in removing contaminants, define the optimal operation for each configuration and identify risk assessment factors. The project will evaluate the energy and reagents consumption, as well as sludge and footprint minimization of the systems. It will carry out lifecycle assessment (LCA) and cost/benefit analysis (CBA) for the environmental and economic impact of the proposed configurations to enable comparison with existing advanced treatments. Through the development of these novel approaches, the project also hopes to improve the operational flexibility and reduce the fouling effects of other reclamation processes, such as hybrid ultra-filtration and reverse-osmosis (UF-RO) systems. By consolidating knowledge about water reclamation technologies and promoting water re-use initiatives among water management bodies, the project hopes to enable both implementation of existing EU environmental policy and further legislation in the re-use of wastewater. It ultimately seeks to contribute to a considerable water re-use scheme at EU level.

PROJECT COORDINATOR:

University of Cyprus

PROJECT PARTNERS:

MATIMOP מתימו"פ
מרכז התעשיה הישראלית למחקר ופיתוח
Israeli Industry Center For R&D

Unioncamere Liguria

LNEG

nireas International Water Research Center

JUST Jordan University of Science and Technology

Ben-Gurion University of the Negev
אוניברסיטת בן-גוריון בנגב

UNIVERSITÀ DEGLI STUDI DI GENOVA
DIPARTIMENTO CHIMICA E CHIMICA INDUSTRIALE