Olive Mill WasteWater: From a major environmental issue to an eco-responsible valorisation.

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Olive oil industry generates → byproducts
Three-phase system → OMWW
(80% water + organics + salts, )

Mediterranean region →
Management → discharge and store in open-air basin

30 Million tons / year
Storage problem (open air):

Rapid drying (sun heating and air flow)

Forms a crust at the interface

→ Mass transfer (water, oxygen) decrease

→ Soil asphyxiation and acidification

→ Sterile soils / river and ground water contamination
OMWW

80 % of water

→ can be a water source (for irrigation, …)

Organic compounds

→ energy supply,

→ soil amendment,

→ fertilizer complement
Strategy

Water for irrigation or fertilizer solutions

+ biomass (sawdust, …)

Drying

Treatment

Energy vector
Heat value ↦

…
Experimental drying tests

- Air temperature and flow rate controlled, 50°C
- Sample thickness studied
- Continuous mass recording,
- Condensation of water in a condensing boiler body cooled by a cooling unit, sampling for analyses of water for reuse purpose
- After drying → heat value of solid by-products

Operating conditions suitable with low-cost solar drying
Experimental results

Drying tests

Impregnation of OMWW on biomass is interesting

→ Quick and effective drying

→ Suitable for a solar unit

→ increase of LHV (→ 20%)
Effective recovery rate (~ 60 % of evaporated water)

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>( \rho ) (( \mu \text{s/cm} ))</th>
<th>COD (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw OMWW</td>
<td>4.8</td>
<td>9730</td>
<td>100</td>
</tr>
<tr>
<td>IS</td>
<td>3.9</td>
<td>233</td>
<td>2.1</td>
</tr>
<tr>
<td>IWC</td>
<td>3.8</td>
<td>267</td>
<td>6.4</td>
</tr>
<tr>
<td>OMWW</td>
<td>3.5</td>
<td>293</td>
<td>8.4</td>
</tr>
</tbody>
</table>
Water recovery

Standards of water quality for irrigation… ex. For Tunisia

<table>
<thead>
<tr>
<th></th>
<th>Tunisia</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM (mg/L)</td>
<td>&lt; 30</td>
<td>~ 0</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>&lt; 90</td>
<td>&gt; 2000</td>
</tr>
<tr>
<td>Faecal coliforms</td>
<td>&lt; 2000</td>
<td>~ 0</td>
</tr>
<tr>
<td>(MPN/100 mL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>&lt; 7000</td>
<td>&lt; 300</td>
</tr>
<tr>
<td>Inorganic ions</td>
<td>= f (ion)</td>
<td>&lt;&lt; standards</td>
</tr>
<tr>
<td>Anions (Cl(^{-}), SO(_4)(^{2-}),...)</td>
<td>= f (ion)</td>
<td>&lt;&lt; standards</td>
</tr>
<tr>
<td>pH</td>
<td>6.5 – 8.5</td>
<td>~ 3.8-3.9</td>
</tr>
</tbody>
</table>

→ Additional analyses (HPLC, µGC, ...) → identification of organic compounds in solution
Water recovery

Identification of chemicals in recovered waters (GC-MS)

In OMWW recovered water
- fatty acids
- tyrosol, glycerol,
- different sugars,
- ...

In waters from Impregnated biomasses (same chemicals + )
- short-chain acids
- amino-acids,
- urea,
- ...

→ Biomasses supplied additional chemicals →
→ Interesting nutriments for agricultural purpose
## Water recovery

Additional treatment for pH → contact with crushed oyster shells and marble powder

<table>
<thead>
<tr>
<th>Solutions “water from”</th>
<th>adsorbent</th>
<th>pH</th>
<th>COD (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMWW</td>
<td></td>
<td>3.5</td>
<td>8.4</td>
</tr>
<tr>
<td>OMWW</td>
<td>Oyster shell</td>
<td>6.6</td>
<td>-</td>
</tr>
<tr>
<td>OMWW</td>
<td>Marble</td>
<td>6.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Impregnated OMWW</td>
<td></td>
<td>3.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Impregnated OMWW</td>
<td>Oyster shell</td>
<td>6.6</td>
<td>1.6</td>
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</tbody>
</table>

pH **ok**
COD not sufficient ✗
After pH correction → agricultural value

Can be used as fertilizer complement for irrigation after dilution

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Nutritive solution for hydroponic agriculture

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Conclusion

Eco-friendly alternatives to OMWW discharge and natural storage are viable

→ Drying of impregnated biomasses

→ After drying, solid by-products can be densified and used as fuel or as soil improver

→ After condensation, water can be recovered and used for irrigation purpose (after pH adjustment and dilution) or fertilizer complement
Thank you for your attention