

# A3w Bio-refinery

## Recycling energy and usable materials from residues of the olive processing

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### 1 Technical description

The A3w bio-refinery uses modular facilities to recycle solid and liquid residues derived from olive production into regenerative energy and organic materials.

The facilities can treat the following base materials:

- Wastewater used in the production olive oil
- Olive husk from two- or three-phase systems
- Olive oils of inferior quality (e.g. those produced using the chemical extraction of olive husk, other plant-based oils, or old organic greases)
- Wastewater and organic residues from dairies, abattoirs, agricultural facilities, etc.

and refine base materials in accordance with the processing lines and the product ranges that will be obtained:

- Olive oil (food quality)
- Bio-diesel(fuel oil)
- Olive pits (fuel)
- Pellets (fuel, fertiliser, animal feed)
- Bio gas (electric energy, heat, cold, steam)
- Water used for spraying
- Compost

The A3w bio-refinery combines the treatment of very problematic wastewater from the production of olive oil (OMW) with the preparation of olive husk. Their connection authorises a closed elimination and transformation plan. In accordance with the market situation, it is possible to strengthen or reduce certain product ranges, which allows the concept of flexible production to be preserved. Thus, this plan is not only appropriate for companies that specialise in waste elimination and wastewater treatment, but the plan is also attractive to investors because of the resulting profits.

The A3w bio-refinery comprises three (with the option of four) principal treatment lines:

#### Wastewater treatment (liquid phase)

The patented AquatecOLIVIA process is implemented, which has been developed especially for an environment-friendly treatment of OMW. The core of this biological/physical process that involves several phases is the methane fermentation of materials contained in the wastewater along with the production of bio gas. The procedure also allows other organic wastewater and waste to be treated simultaneously. The additional treatment phase ensures the drainage values that must be respected. Such by-products as organic sludge and oils are produced when the husk is treated (*cf. AquaTecOLIVIA leaflet*).

#### Bio gas recovery (gas phase)

Bio gas (mainly methane) stemming from wastewater treatment is converted into calorific energy, which satisfies the most of the internal need with regard to heat. In accordance with the supply temperatures for electric energy, a combined heat and power generator with remote heating (BHKW) may be deemed appropriate. The useful heat emitted by the BHKW represents approximately 50% of the calorific value that would be available if the bio gases were used directly without the generation of electricity.

#### Preparing the husk (solid phase)

The A3w bio-refinery integrates the most modern techniques for the treatment of olive husk:

- The separation of oils using centrifuges at temperatures of approximately 50°C. The quantity and quality of this oil depend on the humidity of the husk that is supplied, as well as any impurities that they exhibit.
- The separation of pits using centrifuges. The olive pits, with residual humidity of about 10% and a calorific value of approximately 7 kWh/kg, may be sold directly as fuel. Yield: 0.25 t per 1 t of husk that undergoes the three phases



drying the husk

- Drying out the remaining pulp (the fleshy part of the fruit) in a modern drum dryer or in a fluidised bed system after pelletisation takes place. With a calorific value of 4 kWh/kg., this crude product may be sold as fuel or, after the refinement process, as bio fertiliser. Yield: approx. 0,36 t per 1 t of husk that undergoes the three phases.
- Composting and fermenting (bio gas) represent other possible ways in which the pulp may be converted.



solid fuel

#### Bio-diesel production

The production of bio-diesel is an innovative technology whereby plant-based oils and old greases are converted into diesel. A special process for the decentralised treatment of SMIC (rapeseed methyl ester) rapeseed oil has been modified for the treatment of olive oil (OME).

A compact decentralised facility is set up in order to do this, with levels of production ranging 300 to 1,000 t/years. This bio-diesel is mostly marketed for the region's utility vehicles.

This facility module may also be carried out autonomously, inde-

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pendent of the A3w bio refinery, and is valid from an economic perspective, with a petroleum price of less than 400 € per tonne. The bio-diesel module is an A3w bio-refinery option (cf. leaflet: small bio-diesel facility).



Bio-diesel service station

As a general rule, the appeal of these facilities extends beyond the elimination of residues accumulated during the production of olive oil and includes the production of bio fuels and electric energy.

## 2 Profitability

When determining how profitable a facility might be, an optimal compromise must be found between a treatment facility that is large as possible, the size of the area whose residues is going to be processed, and the associated transport costs. In certain circumstances, it may be wise

to choose a larger area (bio-diesel production, service assistance points), combined with several decentralised units (wastewater processing, wastewater reservoir), for certain modules and devices.

The bio-refinery becomes profitable when individual modules are connected and when marketable products are manufactured.

The facility design is, within defined limits, so flexible that variations in the obtainment of residues and in the market prices for the relevant products can be absorbed.

Table 1 presents characteristic parameters for two typical facility capacities.

In accordance with funding conditions, one facility can be written off at the end of four to seven years. The facilities are designed to be operable for over twenty years.

## 3 Aquatec 3w GmbH

Aquatec 3w GmbH is a company specialising in facility construction and mainly technological engineering in the area of organic waste recycling.

### Services

- ➔ Consulting engineer

- ➔ Technology development
- ➔ Laboratory tests/pilot facilities
- ➔ Engineering-related planning
- ➔ Facility construction
- ➔ Funding and project management



mobile laboratory pilot facility

Since 1997, the team has handled solutions for the elimination of residues of the olive oil and table olive production and has backed its clients when developing and implementing projects. Customised in accordance with what clients want, the services that are provided may be obtained independently or may be packaged together.

### Professional areas

- ➔ residues from olive oil and table-olive production
- ➔ Agricultural and food processing waste
- ➔ Sludge and municipal wastewater (rural area)
- ➔ Regenerative energy
- ➔ Economics based on the recycling of energy and materials

Table 1: model project	Type A	Type B
<b>ENTRY</b>		
Wastewater from olive oil (OMW) <sup>1)</sup>	20,000 m <sup>3</sup> /y	50,000 m <sup>3</sup> /y
Olive husk <sup>2)</sup>	11,400 t/y	33,800 t/y
Other wastewater <sup>3)</sup>	0 m <sup>3</sup> /y	15,000 m <sup>3</sup> /y
<b>EXIT</b>		
Usable water	15,000 m <sup>3</sup> /y	57,200 m <sup>3</sup> /y
Bio-diesel	--	1,200 t/y
Olive oil	400 t/y	--
Solid fuels (pits)	2,200 t/y	8,600 t/y
Fuel/fertiliser/animal feed	3,800 t/y	12,800 t/y
Electric energy <sup>4)</sup>	0 kWh	0 kWh
<b>Costs and revenues</b>		
Investment costs	1,900,000 €	6,568,000 €
Operating costs <sup>5)</sup>	145,300 €/y	560,300 €/y
Yearly revenues (minimum) <sup>6)</sup>	479,000 €/y	1,910,000 €/y
Yearly revenues (maximum) <sup>6)</sup>	1,053,200 €/y	3,629,000 €/y
Other potential revenues	Not assessed	Not assessed

<sup>1)</sup>settling and sedimentation (three phases) <sup>2)</sup>settling and sedimentation (two and three phases) <sup>3)</sup>Distinctive characteristic in this example: dairy wastewater

<sup>4)</sup>The option of a BHKW is not carried out in these examples because the compensation, as far as the supply is concerned, is not attractive. <sup>5)</sup>including compensation for purchase of the husk <sup>6)</sup>according to market conditions

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