IWWATV 2015
Industrial Waste & Wastewater Treatment & Valorisation

# Integrated treatment of waste and wastewater derived from the food industry

http://foodinbio.uest.gr/

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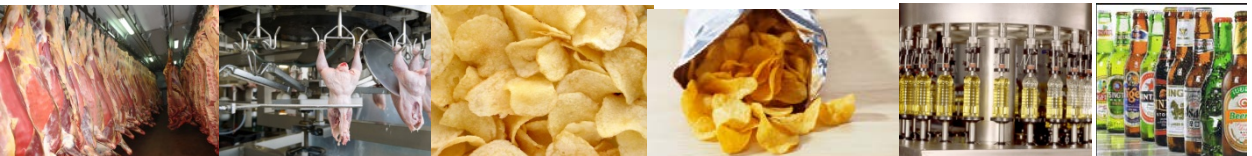


European Union
European Social Fund

OPERATIONAL PROGRAMME
EDUCATION AND LIFELONG LEARNING
investing in knowledge society
MINISTRY OF EDUCATION & RELIGIOUS AFFAIRS, CULTURE & SPORTS
MANAGING AUTHORITY
Co-financed by Greece and the European Union

NSRF 2007-2013
programme for development
EUROPEAN SOCIAL FUND

# EU Food and Beverage Industry

- **EU Food and beverage** industry **is the largest manufacturing sector** in terms of **turnover**, **value added** and **employment**.
- The food and drink industry contributes 1.9% to EU gross value added.
- Throughout the economic recession, **it continued to increase**, while a sharp decrease was observed in other key manufacturing sectors such as the automobile and chemical industries.
- In 2011 **the turnover** for EU-27 reached **more than a million billions Euros** (increase of 6.8% compared to 2010) while the direct employment was stable compared to 2010 (4.25 million employees).
- In total, the EU food industry consists of approximately 287,000 companies **99% of which are SMEs and only 1% of large companies**; however **the latter contributes almost half of the value added of the food sector (48%).**

# EU actions against food waste

The European Commission is taking the issue of tackling food waste very seriously.

- In 2011, the **Commission's Roadmap to a resource-efficient Europe**, identified food as a key sector where resource efficiency should be improved and called for ambitious action to tackle food waste.

- In 2014, the Commission's Communication **Towards a circular economy: a zero waste programme for Europe**, and the related legislative proposal to review recycling and other waste targets put forward objectives for food waste reduction in the EU. It included a proposal for Member States to develop **national food waste prevention strategies** with the aim of reducing food waste by at least 30 percent by 2025. Sectors concerned included: manufacturing retail/distribution, food service/hospitality and households.

# Objective

- **FOODINBIO** project aims at the development of an innovative, compact system that combines biological treatment technologies for the sustainable and environmental friendly management of organic waste streams that are generated from different types of food processing industries i.e.:

  - ✓ Processing and preserving of meat and production of meat products
  - ✓ Processing and preserving of fruit and vegetables
  - ✓ Manufacture of vegetable and animal oils and fats
  - ✓ Manufacture of dairy products
  - ✓ Manufacture of beer

# Actions

**Action 1**: Presentation and Evaluation of Existing Practices Concerning the Management of Organic Waste of Food Industries

**Action 2**: Design, Manufacture and Installation of Innovative System for Combined Biological Treatment of Organic Waste from Different Sectors of the Food Industry

**Action 3**: Demonstrative Operation of the Innovative System of Combined Biological Treatment for Co-Management of Organic Waste from Different Sectors of the Food Industry.

**Action 4**: Evaluation of the Innovative Combined Treatment System

**Action 5**: Publicity and dissemination of research results

# How waste and wastewater from the food industry are treated EU and Greece

*Some examples from the food industry*

# Slaughterhouses: Process

**Animal reception and lairage** → **Stunning and slaughter** → **Bleeding**

***Cattle and sheeps:***
- *Skin removal*
- *Head and hoof removal*

***Pigs***
- *Scalding*
- *Hair and toenail removal*
- *Singeing*
- *Rind treatment*

***Chickens***
- *Scalding*
- *De-feathering*

**Evisceration** → **Splitting** → **Chilling** → **Storage and distribution**

*In **2010** for EU-27 the **meat processing sector was the largest sub-sector**, representing **20% of the total turnover** of the European food and drink industry.*

# Slaughterhouses: Water & Wastewater

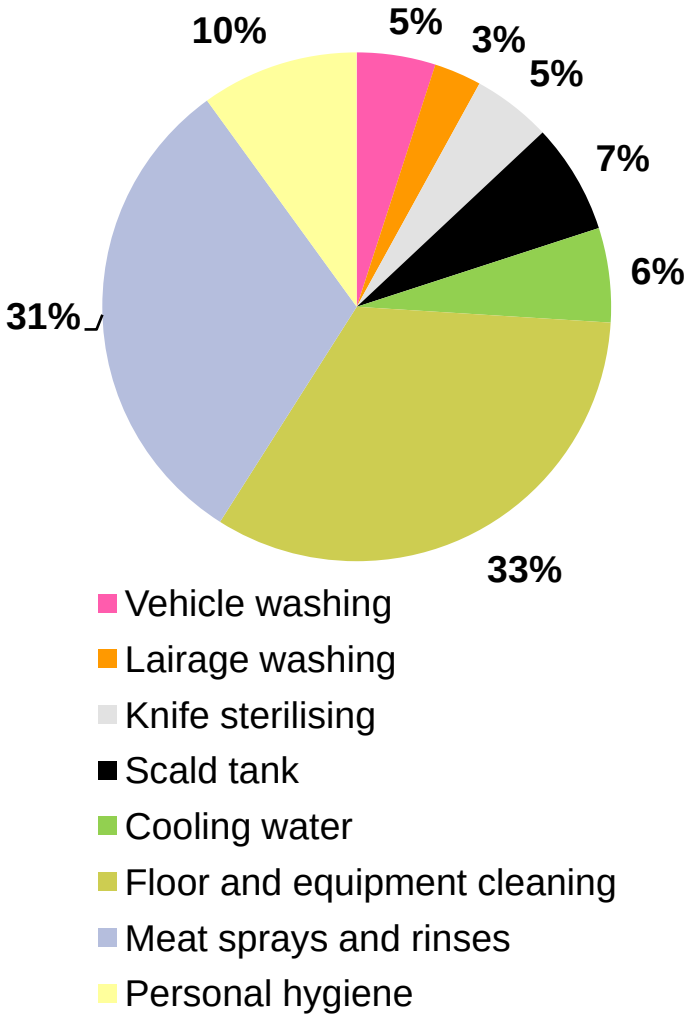
## Typical water consumption:

- ✓ **Pigs** 1.5-10m$^3$/t of carcase
- ✓ **Cattle** 2.5-40 m$^3$/t of carcase
- ✓ **Poultry** 6-30 m$^3$/t of carcase

## Wastewater characteristics:

- ✓ The wastewater from a slaughterhouse can contain blood, manure, hair, fat, feathers & bones.
- ✓ **BOD**: 1 to 4 g/L,
- ✓ **COD**: 2 to 10 g/L,
- ✓ **TSS**: 0.2 to 1.5 mg/L

***Water use for different operations and processes in a pig slaughterhouse***



# Waste and wastewater management from the Greek slaughterhouses (I/II)

*Wastewater treatment*

- ✓ All units operate a wastewater treatment plant.
- ✓ The application of the waste activated sludge process is performed most of the times.
- ✓ The most commonly used practice is the disposal of treated effluent to surface waters.
- ✓ Wastewater treatment in the studied abattoirs comply with environmental and ABPs legislation.

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# Waste and wastewater management from the Greek slaughterhouses (II/II)

## *Solid waste generation and treatment*

- ✓All slaughterhouses with the exception of one operate ABPs treatment facilities including incineration plants or rendering units or both.
- ✓ ABP category 3 can also be exploited through anaerobic digestion for energy production as well as for the extraction of substances and the subsequent manufacture of feedstuffs, cosmetics or medicinal products.
- ✓As observed, blood was collected separately. Nevertheless, the only treatment method detected was the incineration. According to the literature, collected blood can be utilised for the recovery of bioactive peptides to be used in the pharmaceutical industry or as a protein source for petfood.
- ✓Finally, ashes from the incineration of ABPs, which in the case of Greek slaughterhouses are disposed in landfills, can be further exploited since they have high phosphorous content. .

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# Cheese production: Process


*Pasteurisation*

*Separation*
*Standarisation*

*Curd*
*manufacture*

*Moulding*

*Maturation*
*or ripening*

*Packaging*

***World trade in dairy products is concentrated in cheese, butter and milk powder.***

***40% of EU milk is consumed as cheese, with 75% of cheese production concentrated in Germany, France, Italy and the Netherlands***

# Cheese production: Water & Wastewater

## Typical water consumption:

- ✓ 1-4L/L of milk

## Wastewater characteristics:

- ✓ Cheese whey, which is produced after curd manufacturing and washing water of pipelines, storage, tanks &"clean in place" (CIP) systems are the main components of wastewater.

- ✓ **BOD**: 6 to 16 g/L,
- ✓ **COD**: 8 to 77 g/L,
- ✓ **TSS**: 100 to 5,000 mg/L

- ✓ **Conventional treatments:** anaerobic and aerobic digestion processes. ***A number of researchers have claimed that the anaerobic process is essentially the only viable method*** of wastewater treatment with high organic load from cheese making-plants and as a result the majority of studies have been conducted under anaerobic conditions using UASB reactors.

# Waste and wastewater management from the Greek dairy industries

- ✓ Concerning wastewater treatment, most of the studied industrial units operate aerobic biological treatment units while application of anaerobic digestion in combination with aerobic treatment was applied in two units.
- ✓ Biological treatment is the core wastewater treatment method used in all cases. Activated sludge process and in particular the conventional activated sludge system is used most of the times.
- ✓ The treated effluent is mainly disposed to surface waters. Sludge which is produced from the wastewater treatment is usually dewatered and then disposed either to landfill sites or to land.
- ✓ Based on the conducted research none of the industrial units operated a treatment facility of solid waste since the production of solid waste is relatively small and it mainly includes the returned products which in most of the times are given as animal feed.

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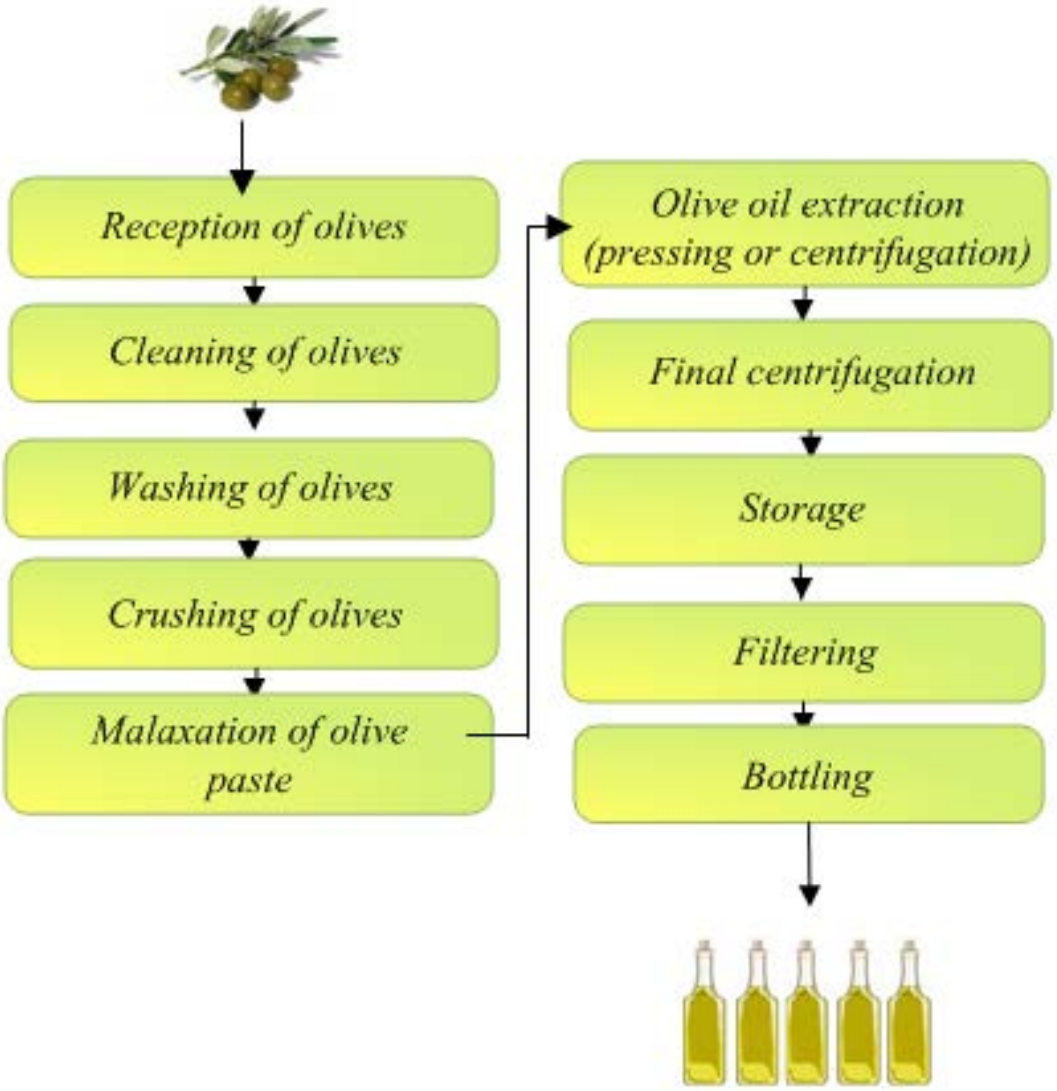
# Olive oil production: Process




*Olive oil is the main* ***fatty component of the Mediterranean diet****. Around* ***73% of world production*** *is produced in EU.* ***Spain, Italy and Greece account for about 97% of EU olive oil production***

# Olive oil production: Water & Wastewater

## Typical water consumption:

- ✓ Three-phase extraction process: 1.25 $m^3$/t olives processed
- ✓ Two-phase extraction process: 0.25 $m^3$/t olives processed

## Wastewater characteristics:

**Concentration values of olive oil wastewater according to applied type of technology**

| Effluent | Value |
|---|---|
| pH | 4.55–5.89 |
| Total Solids (%) | 0.95–16.12 |
| Oil (mg/L) | 410–2,980 |
| Total polyphenols (mg/L) | 400–7,100 |
| COD (mg/L) | 15,200–199,200 |
| Organic nitrogen (mg/L) | 140–966 |
| Total phosphorus (mg/L) | 42–495 |

# Waste and wastewater management from the Greek olive oil production units (I/II)

*Wastewater treatment*

- The prevailing waste treatment method that it is currently applied includes oil collection, neutralization of acidity, sedimentation and disposal to open evaporation ponds (lagoons)

- Evaporation ponds are widely used worldwide despite the fact that in some cases only waste volume is reduced and serious problems might occur due to leakage of wastewater to soil and/or groundwater

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# Waste and wastewater management from the Greek olive oil production units (II/II)

## *Solid waste generation and treatment*

- ✓ Pomace, olive leaves, inappropriate (damaged) olives, ash from the operation of burners, dust due to burners operation or due to drying of pomace and sludge derived from the evaporation, the precipitation and / or septic tanks
- ✓ Pomace handling is 100% undertaken by the olive-pomace facilities, where olive-pomace oil and pomace wood are produced
- ✓ Most Greek industrial units use olive leaves as animal feed or as fertilizer or as fuel
- ✓ Inappropriate olives are available as animal feed or soil improver or for biogas production
- ✓ The ash from pomace wood burners is disposed with municipal waste or to fertilization.
- ✓ Solid residues from oil tanks available for making soap.

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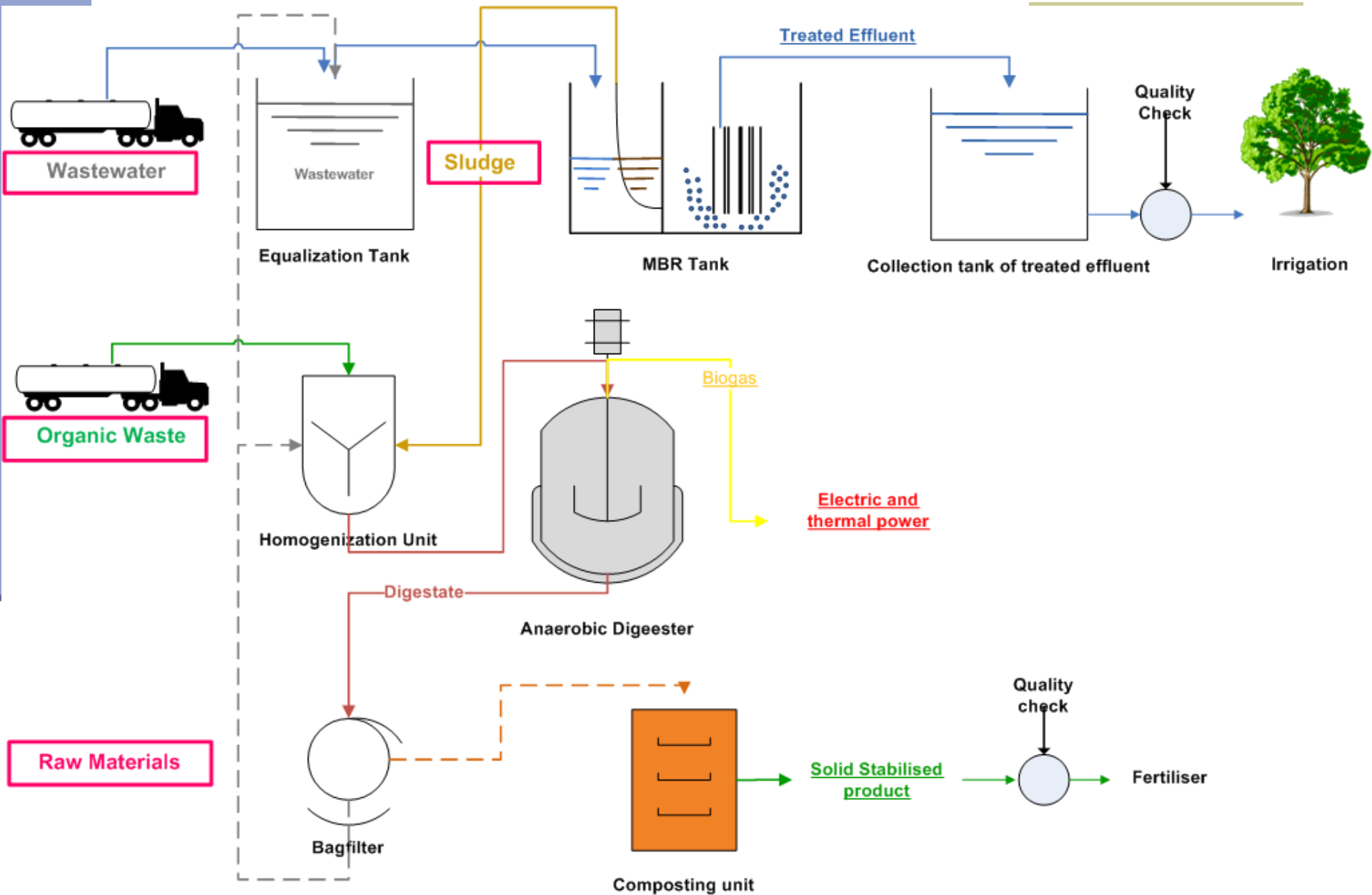
# The integrated system MBR-AD-COMP



# Thank you for your attention

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