The importance of biowaste characterisation. How to do it and consequences.

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(EUPMA)

SESSION 4: Source separate collection of biowaste: How to evaluate it? How to communicate it?

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Who am I?

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Who are we?

Escola Universitària Politècnica del Medi Ambient

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We are a novel University specialized in the fields of chemical and environmental engineering.

At present, we are developing research projects in the fields of:

- composting

- anaerobic digestion

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We also have contracts with different companies working on the biological treatment of organic wastes.

Part of the work presented is from the results obtained from a contract with a composting plant.

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We are part of the Universitat Autònoma de Barcelona.

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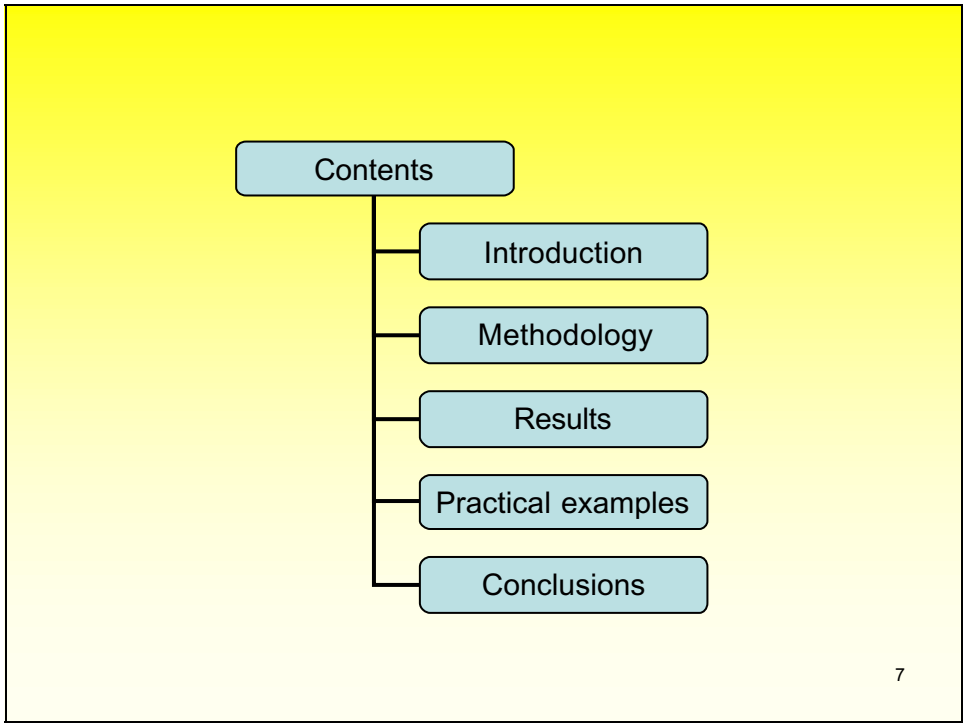
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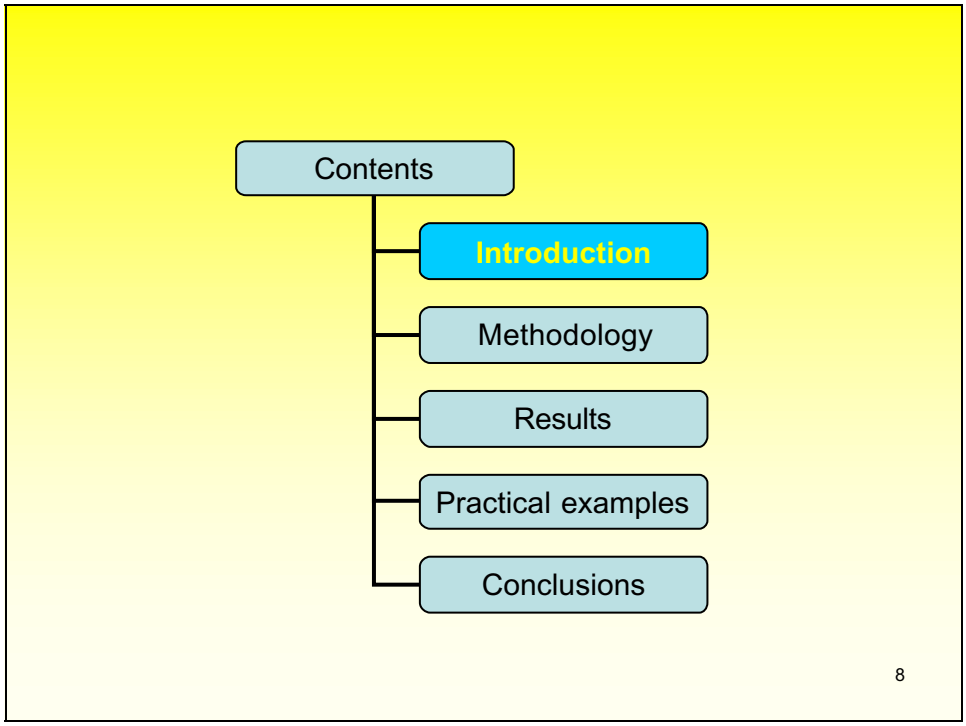
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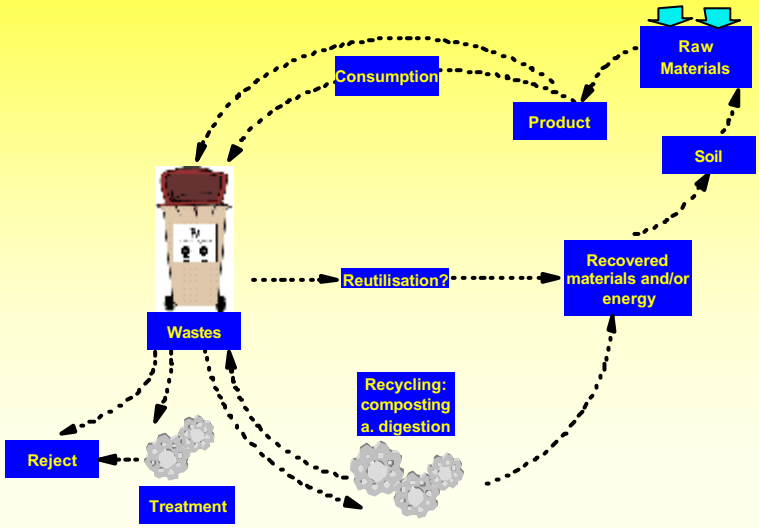
The organic matter cycle in our society:



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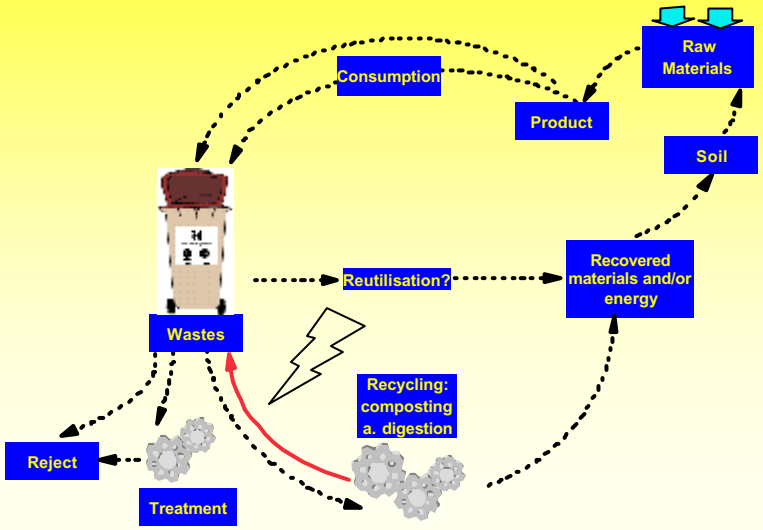
The role of impurities:



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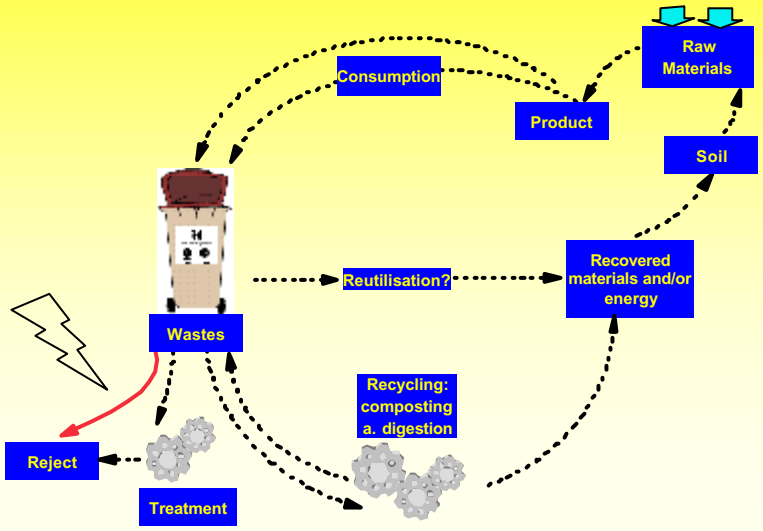
The increase of rejected fraction:



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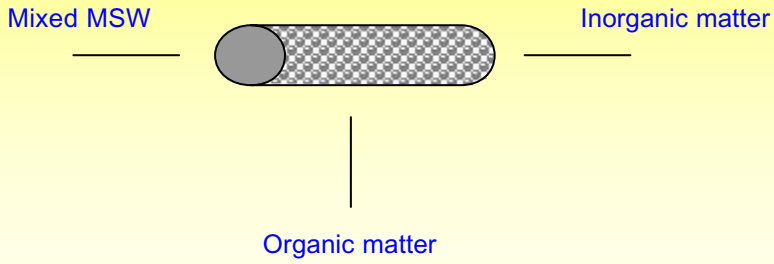
Traditional separation of impurities of organic fraction:



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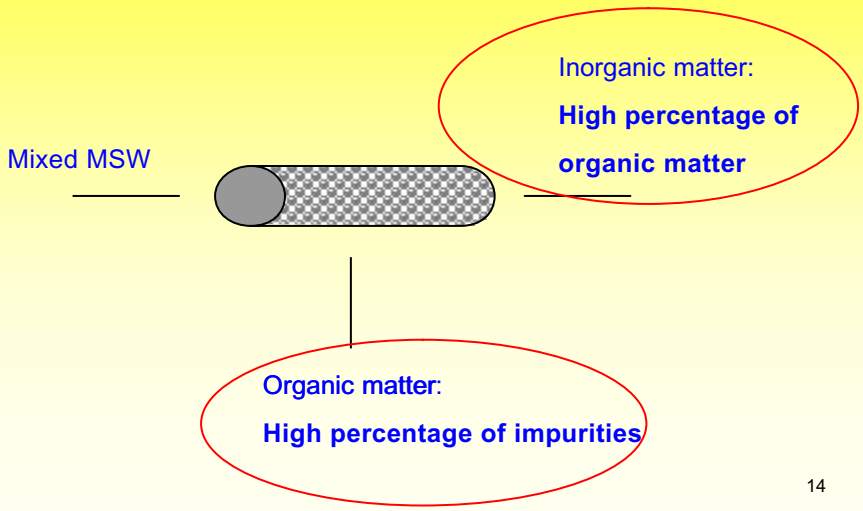
However:



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At present, in some composting plants the separation is carried out after 15 days of process.

This organic fraction:

- is partially decomposed

- is probably hygienised

- has lost moisture

The separation of impurities is easier.

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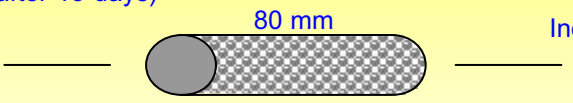
In this case:

Organic fraction of MSW (after 15 days)



Inorganic matter (80-90 %)

Organic matter (>95 %)

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Organic fraction of MSW (after 15 days)

Inorganic (80-90 %)

Organic (>95 %)

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Which problems are associated with impurities in the organic fraction of municipal solid wastes?

In other words…

The presence of "foreign" materials in biowaste can provoke:

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1) A worse quality of the final compost…

(The more obvious problem but not the only one)

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General problems:

2) Process conditions: impurities can act as physical barriers to oxygen diffusion in composting process.

3) Impurities dispersion (plastics, etc.): typical in open facilities.

4) Aesthetic impacts

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Economical problems:

5) Handling costs: turning, pumping, room occupation, etc.

6) Extraction costs

7) Disposal costs: landfill, incineration…

8) Accelerated erosion of equipment

9) Dysfunctions in some equipment: pumps, windrow turners, etc.

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The collection system:

The **quality** of biowaste is directly referred to the source-separated collection system, and its particular characteristics such as:

- the collection system itself

- the level of people's knowledge.

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At present, different systems for biowaste collection are used in the EU:

1) **Containers in public streets**:

a) on the street/under the street:

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b) One compartment/two compartments:

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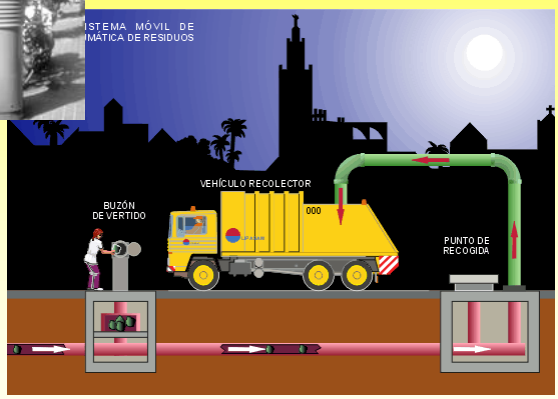
c) Pneumatic collection (mobile or permanent):



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2) **Door to door systems**: they generally need intensive communication programs:

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In the first system, the bin or container is located in the street, and the citizens throw away the biowaste. Therefore, the bin is **anonymous** and accessible to everybody.

Whereas in the second, a bin is **assigned** to every family, and the bin is only accessible to its owner.

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Some characteristics of the two systems for biowaste collection are:

1) Street containers/bins:
   150 g biowaste/person·day
   15-50 % biowaste recovery
   5-15 % of impurities

2) 'Door to door' systems:
   300-400 g biowaste/person·day
   60-85 % biowaste recovery
   < 5 % of impurities

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Another problem associated with street containers is the fact that the rejected fraction is very "polluted" with organic fraction, which in some cases implies a mechanical-biological pre-treatment before landfill disposal, according to:

Directive 99/31/EC of 26th April 1999 on the landfill of waste

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The **objectives** of this work are:

- To test a methodology to characterise biowaste at the input of a composting plant.
- To obtain results of biowaste characterisation in different municipalities.
- To determine the possible consequences of the biowaste quality on the plant performance.

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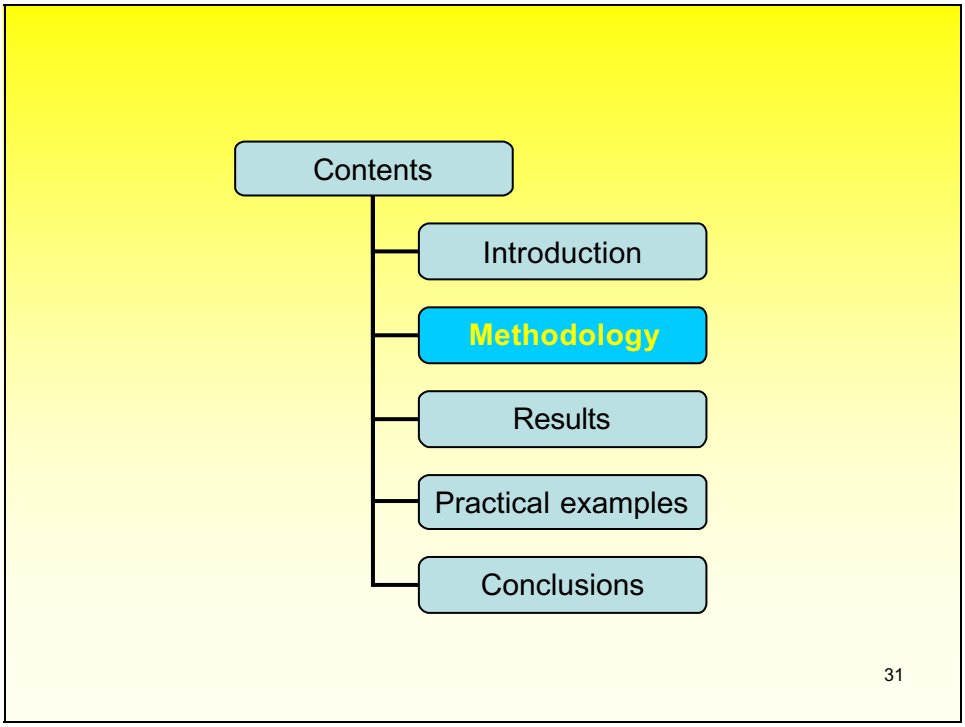

Different entries of a composting plant were characterised.

Two types of characterisation were carried out:

1) **Partial characterisation**:

a) compostable (OFMSW, food and vegetable wastes, compostable bags,…). Although paper can be composted is not included in this fraction, since the priority corresponds to direct recycling.

b) non-compostable: the rest of materials.

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2) **Complete characterisation**:

a) compostable

b) non-compostable:

- plastic (usually the most abundant fraction)
- paper & cardboard
- metals
- glass
- others

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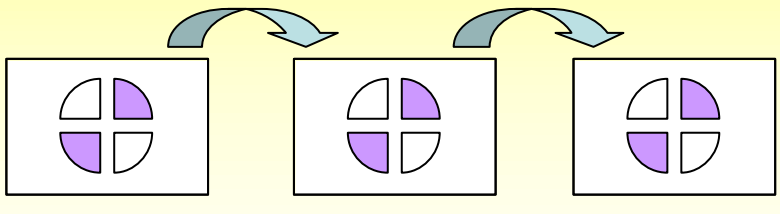
The **methodology** used is based on:

"Scuola Agraria del Parco di Monza. Analisi Merceologico sui refiutti solito urbano".

and implies starting from a sample of 2 tons of biowaste which are reduced to a final weight of approximately 250 kg by successive quartering.



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Some pictures of characterisation procedures…

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Initial wastes as they are received

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Different fractions to get a final weight of 250 kg

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Afterwards, the 250 kg are characterised by **separating** the different types of wastes and determining the weight of each fraction.

The results are reported as **percentage** of weight of each fraction versus initial total weight.

Loss of weight (mainly due to water evaporation and leaking during characterisation) is also reported. Values of total loss during characterisation are around 10%.

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Final characterisation

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What do we need to characterise?

- General equipment: scales, front-end loader, a table, containers.

- Personal protection equipment: gloves, boots, mask, glasses, etc.

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Correction applied for the plastic film fraction?

Often, the plastic film fraction is impregnated of wet organic fraction, which leads to overestimations of the plastic fractions and underestimations of the organic fraction.

A **correction factor** might be proposed for the plastic film.

However, in practice, the organic material adhered to the plastic film will be probably managed as impurity.

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Therefore, this opens another debate…

What is the objective of a biowaste characterisation?

- Evaluation of the collection system?

Apply the correction factor

- Definition of a tax according to percentage of impurities?

Do not apply the correction factor

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How to calculate the correction factor?

The **correction factor** is obtained by dividing the weight of non-used plastic bags typically used for biowastes and a representative sample of wet-dirty plastic bags after separating biowaste.

The correction factor is a measure of the real plastic content present in the plastic fraction.

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Another possible method for obtaining the value of the correction factor could be to dry the plastic fraction and to assume that the remaining material corresponds to plastic.

The error in this case is related to the organic matter of the material adhered to plastic fraction.

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Nevertheless…

We still don't have real values of the correction factor.

But in our opinion the correction factor will be lower than 0.5, which indicates that plastic bags content high amounts of water and organic wastes, which are usually lost.

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This opens **another debate** about the convenience of using plastic non-biodegradable bags to dispose biowastes.

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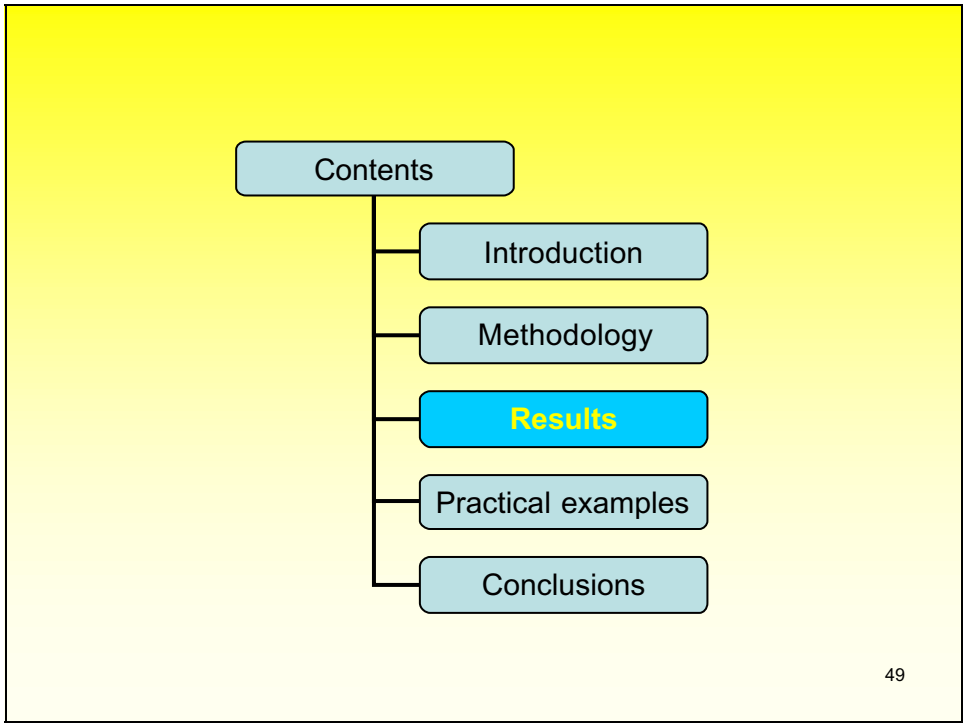

Global results obtained in biowaste characterisation:*

Munic.	Inhabitants	Collection system	Impurities (%)
1	6800	Street container	**6.8**
2	13200	Street container	**7.5**
3	13200	Street container	**9.7**
4	54600	Street container	**14.5**
5	12300	Street container	**14.5**
6	12400	Street container	**9.8**
7	48700	Street container	**16.5**
8	13200	Street container	**17.0**
9	9400	Street container	**10.4**
10	187200	Street container	**14.5**
11	17700	Street container	**14.1**
12	3900	Door to door	**1.4**
13	6500	Door to door	**1-3**
14	6000	Door to door	**1**

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*Source: EUPMA and other studies

All the global results showed biowaste percentages within the range of 85-99%.

In street containers, very few characterizations showed values of purity over 90%.

There is no correlation between population and impurities.

Only those characterisations from 'door to door' systems reached impurities values below 5%.

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Specific results (**complete characterisation**):

Biowaste		**83.5**
Others		**16.5**
Others	**Paper**	2.9
	Plastic*	8.6
	Glass	0.7
	Metal	0.6
	Others**	3.7

* Not corrected by the correction factor.

** Include: ceramics, some batteries, textiles, etc.

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Plastics accounts for more than half of the impurities found in biowaste.

However, applying the correction factor this percentage would be lower, and the total purity of biowaste would be higher.

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Anyway, if plastics are separated in a conventional pre-treatment operation, this water and organic content will be probably lost.

In composting plants, however, if the separation of impurities is conducted after a 15-days period of composting, there is a significant reduction in the organic matter loss.

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Specific results (**volume characterisation**):

Material	% Weight	% Volume	Ratio
Biowaste	**89.6**	**67.2**	**1.3**
Food waste	71.4	44.3	1.6
Green wastes	18.2	22.9	0.8
Impurities	**10.4**	**32.8**	**0.3**

Material	% Weight	% Volume	Ratio
Biowaste	**93.2**	**78.9**	**1.2**
Food waste	89.7	70.4	1.3
Green wastes	3.5	8.5	0.4
Impurities	**6.8**	**21.1**	**0.3**

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Plastics accounts for a very high volumetric percentage of impurities, since their bulk density is very low.

In fact, the high volumetric ratio of impurities is mainly due to the high percentage of plastics.

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On the other hand, in some municipalities, green wastes can account for a significant percentage of total biowastes, and a higher volumetric percentage.

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Green wastes can be classified into:

- **Leaves or grass**, which should be collected jointly with kitchen wastes.

- **Pruning wastes (branches)**: in general, green wastes that need grinding,

This wastes should have alternative collection systems, such as "green points" or composting plants, since their bulk density is very high, and in some municipalities can collapse the collection systems.

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Specific results (**trommel separation**):

Fractions from trommel	% < 80 mm	% > 80 mm
Biowaste	97.1	71.0
Other	2.9	29.0
% of each fraction	55.9	44.1

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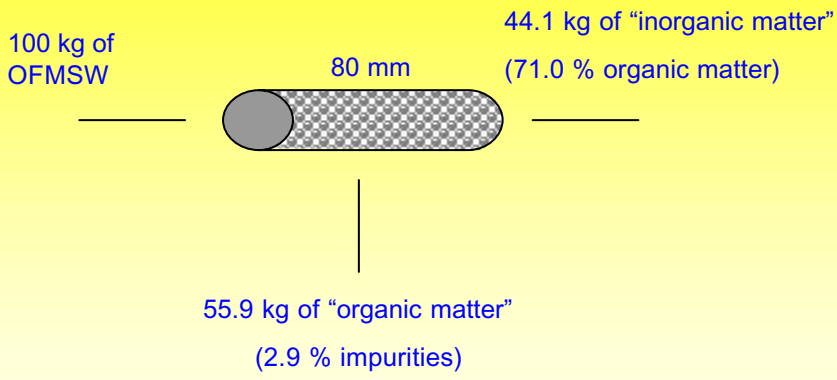

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Size-based separations (such as trommel separation) reduce significantly the percentage of impurities.

However, the loss of organic matter is very important. **This operation should not be carried out with fresh wastes**.

Again, a composting 15-days period can improve the trommel separation.

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Some pictures of biowaste:

In the characterisation, difference in entries are sometimes visible.

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For instance, this is how a good quality waste looks…

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However, sometimes plastic bags remains.

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This is a bad quality biowaste input…

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Sometimes, they could hardly be called 'biowaste'.

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Nevertheless, sometimes the way a biowaste looks is not directly related to its purity.

Thus, some fractions that visually can be qualified as 'high quality' often content percentages of impurities over 15%, whereas other fractions with more visible contaminants are below 10%.

In general, we think that the characterisation is **necessary** to have objective results.

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Example 1:

Municipality 1:

- 65440 inhabitants
- 1.35 kg MSW/(inhabitant·day)
- 38 % biowaste

approximately 12250 t of biowaste/year

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Landfill price: 22 €/t + 10 €/t (tax) = 32 €/t

= 392000 €/year

Composting price: 24 €/t

= 294000 €/year

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Example 2:

Municipality 2:

- 12454 inhabitants
- 1.09 kg MSW/(inhabitant·day)
- 38 % biowaste

approximately 1883 t of biowaste/year

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Landfill price: 28 €/t + 10 €/t (tax) = 38 €/t

= 71554 €/year

Composting price: 27 €/t

= 50841 €/year

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Composting is becoming economically more attractive than landfilling.

Additionally, the tax of 10 €/t will be returned to support source-separated collection systems.

Source separated collection programs will be encouraged.

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However, **a good quality of biowaste should be required**. For instance, prices for composting could be arranged as:

< 5 % impurities: 22-25 €/t

5-10 impurities: 33 €/t

10-15 % impurities: 43 €/t

> 15 % impurities: 55 €/t (or not accepted)

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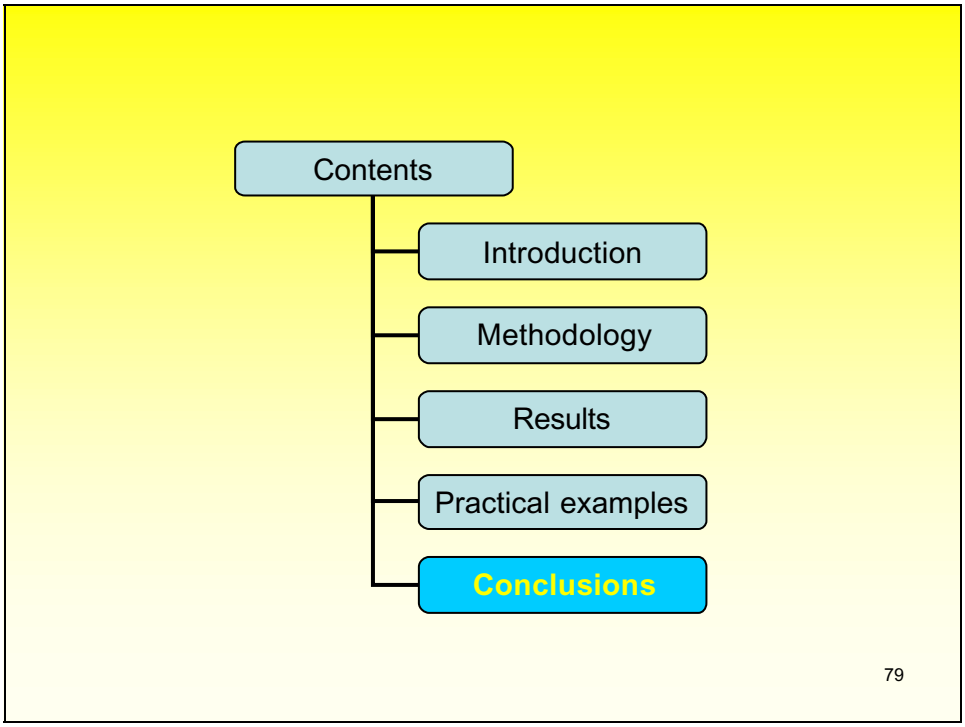

At present:

Characterisation of biowaste is a crucial factor for two aspects:

Evaluating the **quality** of a source-separation collection system and proposing improvements.

Determining the **cost** of processing 'foreign' materials for the biowaste treatment plant (composting or anaerobic digestion).

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In the short-term future:

Biowaste processing plants might have the possibility of having a **tailor-made tax** (some already have it) for the wastes entering the plant, calculated according to the percentage of non-biodegradable wastes.

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Taxes from landfill disposal (for instance, 10 €/t in Catalonia in 2004) will be reverted to the optimization of the collection systems.

This will promote the municipalities to focus on information campaigns to improve the quality of biowaste collection systems.

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Finally:

A protocol to determine the characterisation of biowastes has been tested with real wastes.

Further improvements of the protocol (e.g. the plastic film correction) can be included in new characterisations.

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Thank you very much for your attention…

And thank you to the people who made this work possible:

- Maria Teresa Gea
- Raquel Barrena
- Estel·la Pagans

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