

Characterization of Municipal Solid Waste to estimate biodegradability for mechanical biological pretreatment and landfilling

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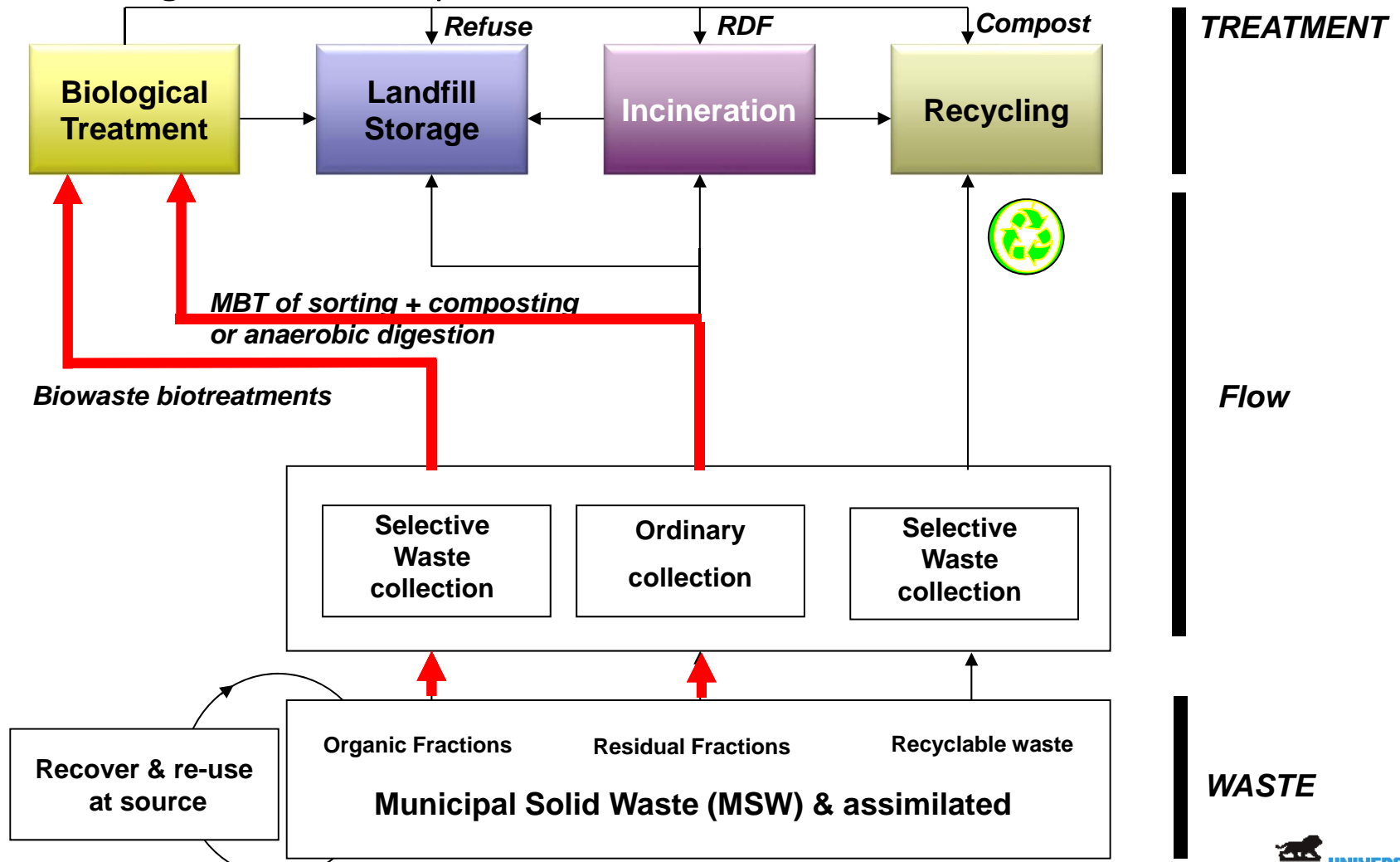
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1- Overview and questions related to MSW management and bio-treatments

➤ MSW Management in Europe



1- Overview and questions related to MSW management and bio-treatments

High variability of the waste flow... might be problematic to control residual MSW or biowaste treatments.
Consequently, it is necessary to have a good waste characterization for the design of bioprocesses, such aerobic treatment (composting or biodrying process) and anaerobic digestion (AD).
And...

- Estimating the potential of bioconversion of the organic fraction,
- Modeling the process and having a better understanding of the biological activities.
- Optimizing the whole process (Sorting operations, feedstock pretreatments, co-treatments,...)



WASTE

Objectives

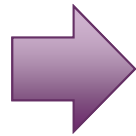
Quantification of the biodegradable organic fraction from mix MSW or biowaste (variability) are relatively complex and requires considerable sampling work, and analytical procedures

1- determine the relationships between bioreactivity versus MSW composition and characteristics

2- select relevant tests to evaluate biodegradability of a large profile of solid waste fractions from MSW

2- Methodology

Solid waste sampling on MTB plant



**Sieving and
sorting on
tables:**

- > 100 mm
- 20-100 mm
- < 20 mm (fines)

and

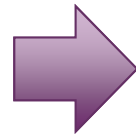
Identification of
13 categories



French standard Method MODECOM™

2- Methodology

Solid waste sampling



Sieving and sorting on tables:

- > 100 mm
- 20-100 mm
- < 20 mm (fines)

and

Identification of 13 categories

● Putrescible waste (food and green waste)	18.7%
● Fines (< 20 mm)	34.9%
● Papers (office papers, magazines, newspapers)	21,1%
● Cardboards (including cellulosic packaging)	15.5%
● Textiles (cotton, ...)	0.5%
● Sanitary textiles (diapers,...)	3.0%
● Non classified combustibles	0.8%
● NCC (wood pieces, ...)	5.1%
● Composites (Tetrabricks, multi material packaging)	0.5%
● Plastics (bottles, piece of plastics...)	
● Glass (bottles, pieces of glass > 20 mm)	
● Non classified Incombustibles NCI (stones, gravels,...)	
● Metals (cans, pieces of metals,...)	
● Special waste (batteries, electronic waste,...)	

Global analyses

Biochemical analyses

Bio-tests

BOD

BMP

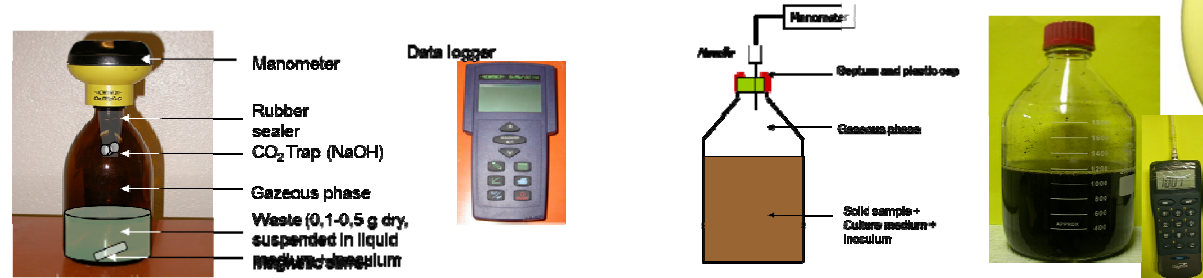
2- Methodology

- VS and Total COD (TCOD, dichromate oxidation)
- Leaching behavior: pH, conductivity (G), soluble COD (leaching test L/S = 10, 3h)
- Carbohydrates (van Soest's sequential extraction): Soluble (SL), HEM, CELL, RES ("lignin-like")
- BOD measurement on suspended solid samples
- Biomethane potential (BMP) on suspended solid samples

Global analyses

Biochemical analyses

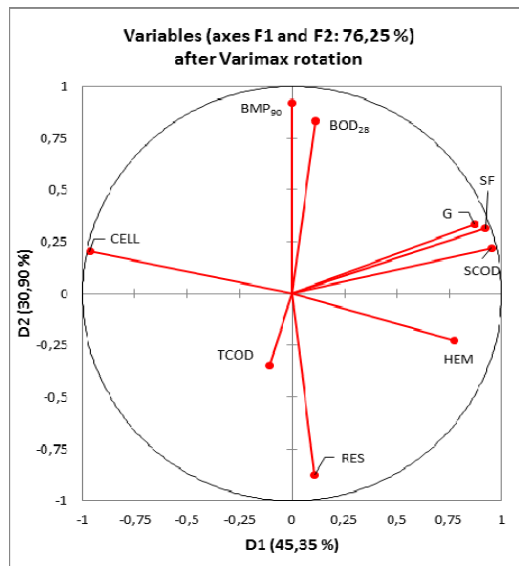
Bio-tests
BOD
BMP



3- Results and discussion

Statistic approach: Principal Components Analysis (PCA) was used to investigate the relationships amongst the variables obtained from all selected fractions and compare it.

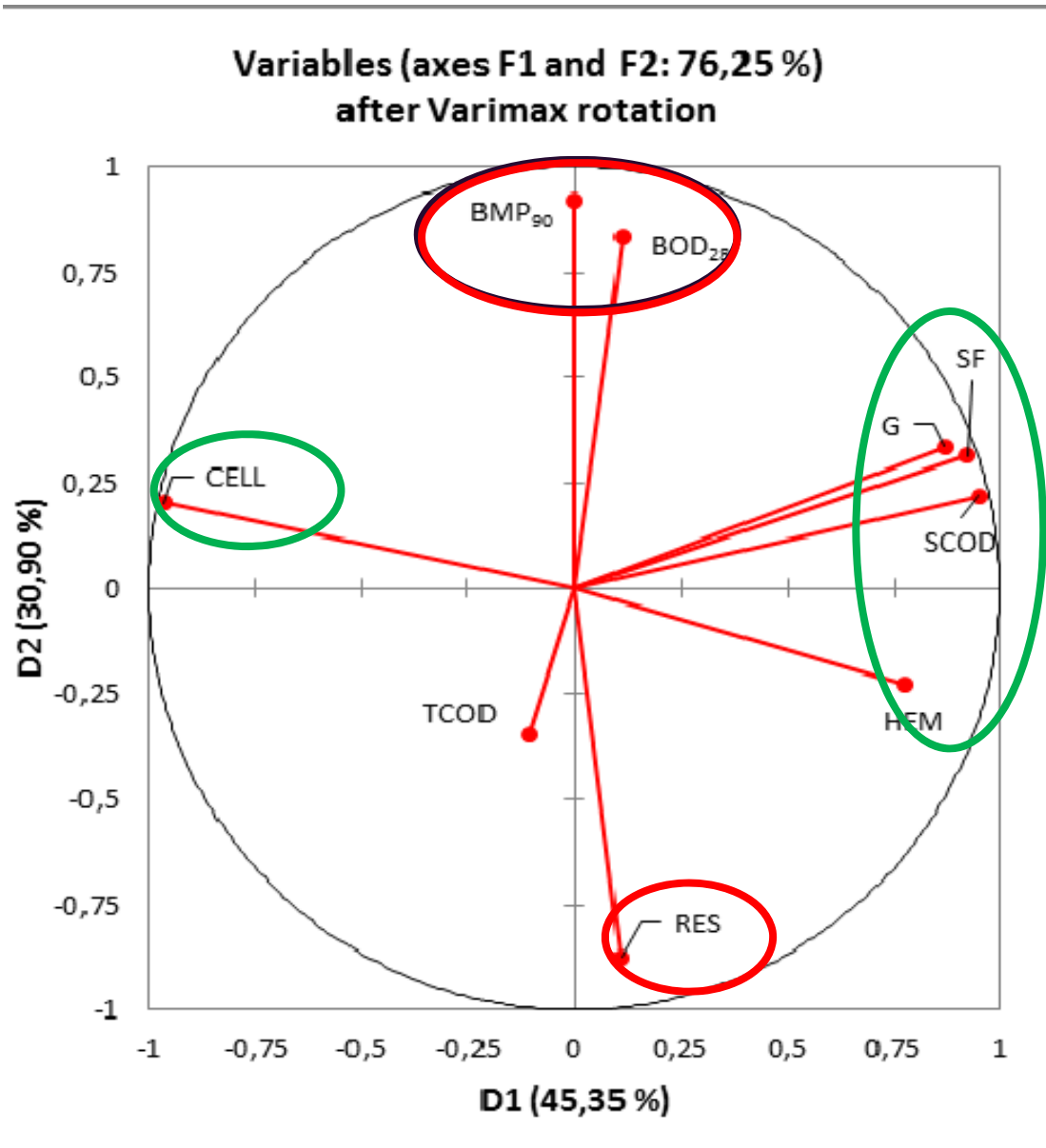
*PCA is a multivariate statistical data reduction technique where the new **variables** (principal components or factors) from **samples** are calculated from linear combinations of the original variables. If two data are orthogonal to each other, so there is no correlation. The first principal component, or factor, accounts for the greatest variability in the data. XLstat[®] software was used to perform the PCA and get correlation matrix and build illustration like the following figure:*



The first two PC, represented $\approx 76\%$ of the variability of the data

3- Results and discussion

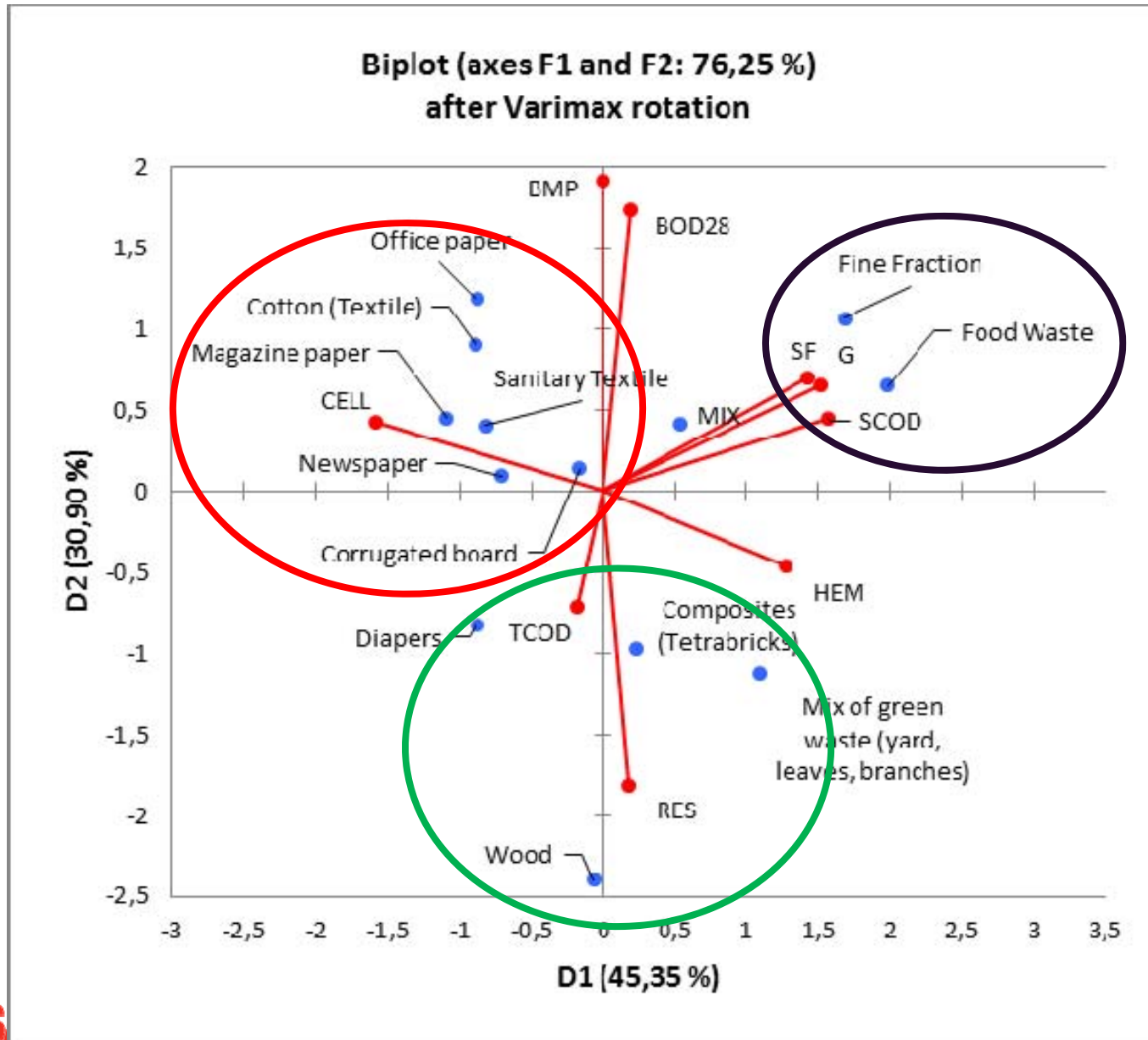
Variables



- Correlation between BOD and BMP
- No correlation between BMP and soluble, hemicellulose and cellulose
- Relevant biochemical variable to estimate biostability: “Lignin-like” (RES) fraction, in opposition to BMP and BOD

3- Results and discussion

MSW Sub-fractions /variables

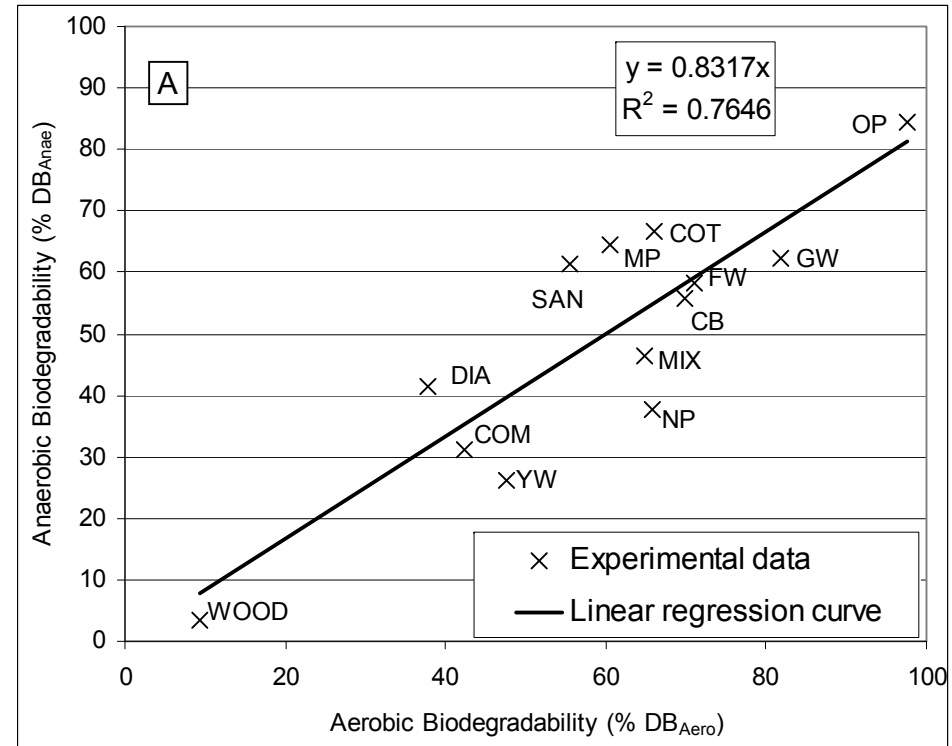


3- Results and discussion

Correlation between BD_{Ana} / BD_{Aero}

$$BD_{Aero} = \frac{BOD}{TCOD} \times 100$$

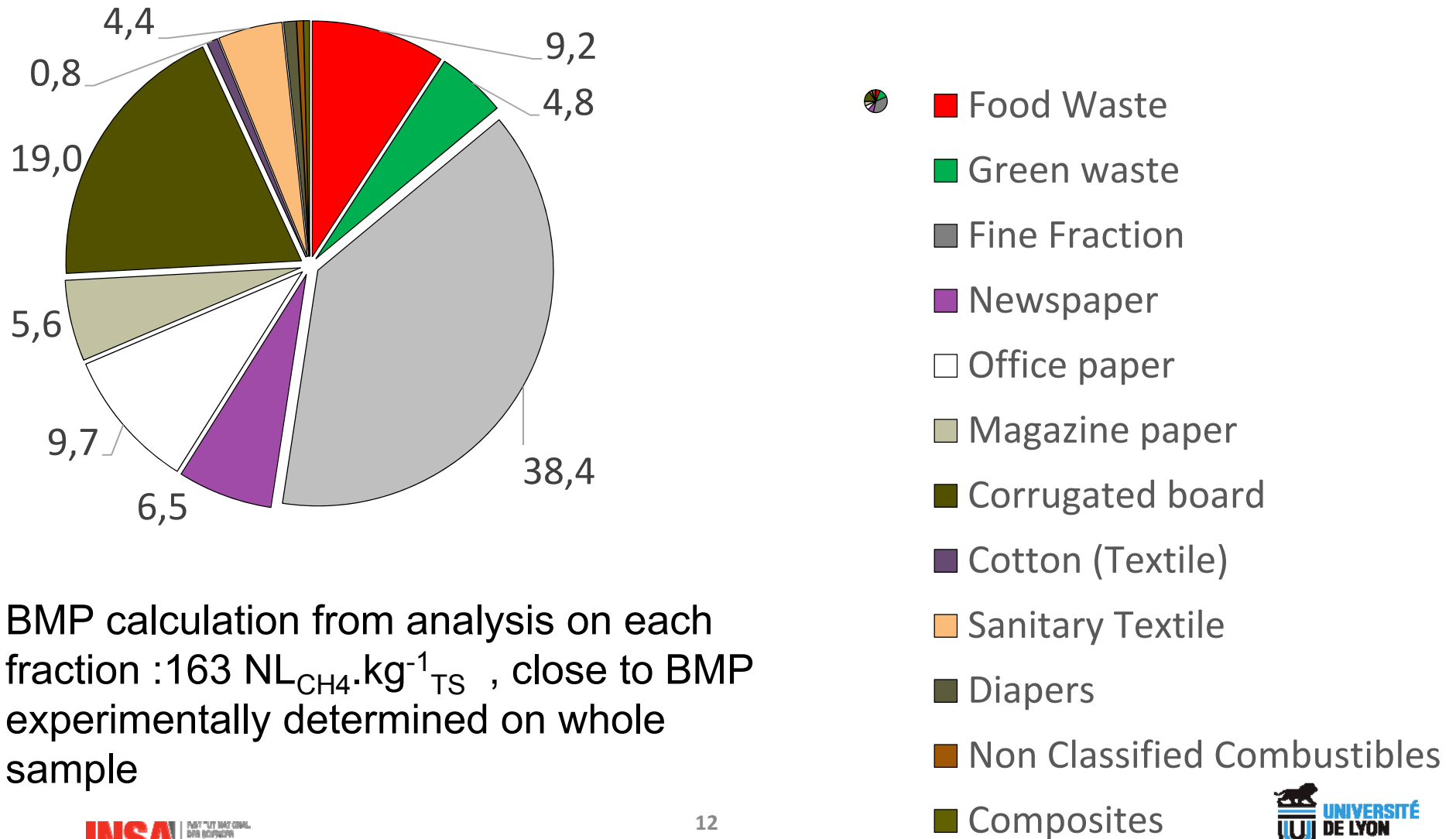
$$BD_{Anaero} = \frac{BOD}{0,35 \times TCOD} \times 100$$



- Less biodegradability under anaerobic condition,
- Significant linear correlation between BMP and BOD tests,
- Structural effect of organic fraction, reducing OM bioaccessibility

3- Results and discussion

BMP distribution



BMP calculation from analysis on each fraction : $163 \text{ NL}_{\text{CH}_4} \cdot \text{kg}^{-1}_{\text{TS}}$, close to BMP experimentally determined on whole sample

4- Conclusions

- Linear correlation between aerobic and anaerobic bioreactivity (confirmed on more samples),
- no correlation occurred between biodegradability with variables from leaching test and Van't Soest sequential extraction excepted for the non-extractable RES fraction
- Additivity of the parameters measured separately on each MSW fraction compared to the result obtained on waste sample recomposed of mixed fractions : promising results to estimate aerobic or anaerobic biodegradation from MODECOM composition data

Thank you for your attention!



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