PRECEPT 1: WASTE CHARACTERISATION, SEPARATED COLLECTION

1

An example of waste composition is reported in the table. Values refer to the weight of the wet waste. Evaluate the waste composition referred to the dry weight.

Waste category	Wet weight (%)	Moisture (%)
Paper and cardboard	18	18
Textile and wood	3	20
Organic fraction	31	70
Plastic and rubber	13	3
Fine fraction	26	40
Metals	4	3
Glass and inert	5	3

2

A plastic and rubber waste has a DLHV (Lower Heating Value evaluated on the weight of the dry waste) equal to 31500 kJ/kg $_{dry\ waste}$. Evaluate its HHV (Higher Heating Value) and LHV assuming that the moisture (M) is equal to 6% on weight and the Hydrogen (H) content is equal to 5% on weight.

3

An example of municipal solid waste composition is reported in the table:

Waste category	% on weight	Moisture (% on weight)	DLHV (kJ/kg $_{dry\ waste}$)
Organic fraction	30	60	18220
Paper and wood	30	20	21400
Plastic	15	10	37870
Glass and inert	10	0	0
Fine fraction	15	20	15130

1) Evaluate the LHV and DLHV of the waste;
2) If the glass and the inert materials are collected at the source with an efficiency of 70% and paper and wood and organic fraction are collected with an efficiency of 30%, evaluate the efficiency of the separated collection and the moisture and the LHV (KJ kg^{-1}) of the residual waste.

4

The waste production in a province of 600000 inhabitants in 2011 is reported in Table 1. The separated collection value refers to the amount of municipal waste separated at the source.

The residual waste (i.e. the waste after the separated collection) composition is reported in Table 2. Data about the separated collection and the production of batteries, cans and expired medicines before the separated collection are reported in Table 3.

Table 1: Waste production

Waste category	Yearly production (t/year)
Residual waste (RW)	283000
Bulky waste (BW)	13000 (of which 6000 as recovery)
Urban like waste (ULW)	74000
Sludge (S)	57000
Separated collection (SC)	60300

Table 2: Residual waste (RW) composition and LHV

Waste category	% on weight	LHV (kJ/kg)
Paper/cardboard	26.0	13395
Plastic	13.5	26958
Glass	8.3	-
Organic fraction	29.2	7577
Textile	5.2	15321
Metals	4.2	-
Fine fraction and others	13.5	6028

Table 3: Separated collection

Waste category	Per-capita separated collection (kg/person/year)	Per-capita production (kg/person/year)
Paper/cardboard	60	n.a.
Plastic	20	n.a.
Glass	20	n.a.
Batteries	0.1	0.3
Aluminium cans	0.3	0.5
Expired medicines	0.1	n.a.

Part 1:

Questions:
1. Evaluate the per-capita daily production of each waste category reported in Table 1;
2. Evaluate the separated collection efficiency (ηSC) of the urban waste in the province, verifying the fulfilment of D. Lgs. 205/2010
3. Evaluate the yearly per-capita production of plastic, glass and paper and cardboard;
4. Evaluate the percentage of source separated waste (ηSC_i) for each waste category;

Part 2:

The separated collection of the food waste produced by the large users (196 t/year) and of the garden waste (175 t/year) is implemented in one of the province cities (with 10000 inhabitants).

Questions:
1. Evaluate the amount of these two fractions collected at the source in the target city per person and per year;
2. Evaluate the efficiency of the separated collection if the source separation of the food waste from the commercial activities and of the garden waste is implemented in the whole province.

Part 3:

Evaluate the separated collection efficiency if the source collection of the domestic food waste, with an efficiency of 60%, is implemented in addition to the collection system described in part II (food waste by the large users and garden waste).

The category called organic fraction in Table 2 includes the food waste by the large users, the domestic food waste and the garden waste.

Part 4:

An alternative scenario for the separated collection is reported in the following table.

Waste category	Per-capita separated collection (kg/in/year)
Light packaging flow (paper, cardboard, plastic and aluminium)	200
Glass collected in street containers (with citizens awareness campaign)	40
Garden waste	18
Food waste by large users	20
Domestic food waste	60
Batteries and expired medicines	0.3

Evaluate the efficiency of this alternative scenario for the separated collection.

 # 5

The organic fraction of the waste is analyzed to evaluate its moisture, ash and volatile solids content. At this purpose, a representative sample is opportunely grinded and then put in a crucible (A ceramic container that supports temperatures higher than 950°C) whose weight (T) is previously measured. The crucible, filled with the waste sample, is weighed (W_T) and then put in a oven at 105°C for some hours. The crucible with the dried waste is weighed (W_{T105}) and then put in a muffle furnace at 950°C for some hours and weighed again (W_{T950}).

Assuming the following weights:
$T = 312.3g$; $W_T = 395.8g$; $W_{T105} = 353.1g$; $W_{T950} = 321.0g$
evaluate the moisture of the waste and the volatile solids and the ash content (%) in the waste sample referred both to the total and the dried weight.