Refuse Derived Fuel from Municipal Solid Waste rejected fractions- a Case Study

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Introduction

Municipal Solid Wastes (MSW) that contain mixtures of paper, wood, green wastes, food wastes, plastics, leather, and rubber can have energy characteristics similar to wood. Use of MSW as a fuel can be accomplished by burning the as-received material, called mass burning, but processing is often required before it can be burned effectively. The purpose is to reduce size and remove materials, valuable materials or non-combustible materials in order to be reclaimed and used as alternative fuel for sustainable disposal and converted into green and clean energy.

The impact of burning these heterogeneous materials in traditional boiling systems, as primary or supplemental fuel, needs to be assessed: the physical and chemical characterization of raw materials should be performed. According to Portuguese Standard NP 4486:2008, a classification system is used based on Refuse Derived Fuel (RDF) main parameters: lower heating value, chlorine and mercury content.

Higher heating value is in fact associated with paper/card, plastics, wood and textiles content and, once these materials have in their composition biogenic compounds (40-80% w/w), they become an interesting alternative fuel to accomplish the reduction of CO_2 emissions.

Objective

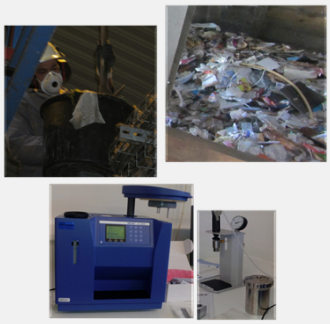
To characterize the rejected streams from the mechanical treatment of unsorted MSW (MBTR), from the rejected residual fraction from plastic municipal selective collection (SCR) and from the rejected fraction from the composting treatment (CR), in order to evaluate their potential of valorisation as RDF.

Case Study

An integrated MSW management system serving 19 municipalities and 350 000 inhabitants, where municipal and industrial non-hazardous solid wastes are mainly landfilled.

Material and Methods

- Physical Caracterization
- Proximate Analysis
- Chlorine Content
- Higher Heating Value (HHV)
- Lower Heating Value (LHV)



Results

Physical Caracterization (%)

SCR

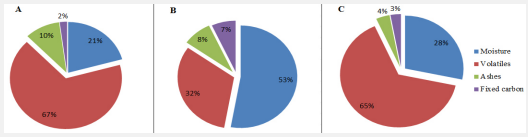
Type of waste	Sampling campaign							
	1	2	3	4	5	6	Avg	s
Food/green wastes		2.7			2.4		2.5	0.19
Plastics	21	30	50	19	22	63	34	18
Paper/cardboard	48	49	22	42	204	29	35	13
Textile	6.0	6.1	12	29	39		18	15
Tinfoil				0.77	0.19		0.48	0.41
Cork/Wood				0.32	0.42	1.1	0.60	0.41
Inerts		4.9	4.5	4.6	6.4		5.4	0.88
Metal						4.4	4.4	-
Others	24	7.9	12	3.7	9.5	2.6	10	7.9

MBTR

Type of waste	Sampling campaign						
	1	2	3	4	5	Avg	s
Food/green wastes	50	39	43	38	43	43	4.7
Plastics	12	13	11	14	11	12	1.3
Paper/cardboard	18	22	3.9	18	12	15	7.1
Textile		4.7	9.2	10	12	9.0	3.1
Tinfoil							
Cork/Wood			1.80	1.30		1.55	0.35
Inerts	20	21	8.6	4.2	6.3	12	8.0
Metal			1.6	2.5	1.3	1.8	0.62
Others			19	12	16	16	3.6

Avg – average; s – standard deviation

Proximate Analysis (%)



A – SCR; B- MBTR; C - CR

Overall, CR and SCR showed similar proximate analysis, excepted for the ashes content. This fact may be related with the higher plastic content and lower wood content of SCR compared to CR.

Cement Industry : 20% Moisture

% Moisture ⟷ LHV Value

Combustion Efficiency

Chlorine Content (%)

	Sampling campaign						Avg	s
	1	2	3	4	5	6		
MBTR	0.41	0.13	0.56	0.16	1.19		0.49	0.10
SCR	0.07	0.22	0.19	0.25	0.37	0.19	0.22	0.06

MBTR presented higher chlorine content than SCR and CR.

These percentages suggest the absence of difficulties in using RDF in cement kilns combustion and afterwards in produced cement quality.

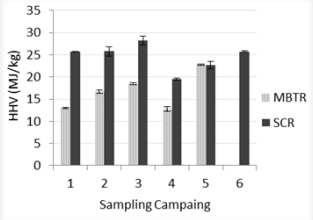
Classification due to Cl according NP 4486:2008

SCR - class 1 CR - class 1 MBTR - class 2

Heating Value (MJ/kg)

HHVs were greater than 10 MJ/kg. The SCR stream presented the highest HHV showing potential for RDF production. CR had a higher heating value of 24.22 MJ/kg.

LHV is 23.06, 22.88 and 15.53 MJ/kg for SCR, CR and MBTR, respectively. Fractions rejected from selective collection and from composting have LHV not very different from coal.



RDF

RDF preparation is very important and dependent on MSW composition and type/performance of specific unit operations employed for preparing fuel from waste. Considering the conversion factors for power plants (25%), with the calorific values achieved with the rejected streams, accounting the amount of wastes production in 2015, the energy that could be produced from SCR, MBTR and CR is higher than 500 MWh/year.

	SCR	MBTR	CR
Energy Produced (MWh/year)	588	1154	1699
CO_2 Emissions (kg CO_2-eq.kg^{-1})	0.993	0.247	0.545

Taking on account the wastes physical and chemical composition, it is expected that the CO_2 emissions obtained for RDF. It is also important to emphasize the production of green energy and the decrease of landfill deposition, in a perspective of "Zero Carbon Landfill" and, consequently, the increase of landfill lifetime.

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Conclusions

- MBTR, SCR and CR are rather different in water content, organic matter and ashes, as well as in terms of heating value and chlorine content.
- RDF has an important role as an additive to fossil fuels, allowing economical savings but moreover the reduction of CO_2 and other greenhouse effect gases emissions.
- Studied MSW rejected fractions characteristics are compatible with the production of an high quality RDF, thus being an important resource advantageously replacing fossil fuels primary energy