ENERGY-WASTE

LIFE09/ENV/GR/00307 : **ENERGY** EXPLOITATION OF NON-RECYCLABLE URBAN **WASTE** IN A SUSTAINABLE WASTE-TO-ENERGY MARKET

REFUSE DERIVED FUEL ANALYSES

Discover...
how much you can recover

1 Scope

Scope of project **LIFE09/ENV/GR/00307 : ENERGY WASTE** is to:

- Study
- Develop
- Implement

an advanced gasification concept for the energy exploitation of non-recyclable waste stream produced in a recycling factory.

Consortium:

- EPANA S.A.
- Center for Research and Technology Hellas-Institute for Solid Fuels Technology & Applications
- The Prefecture Authority of Thessaloniki and
- European Renewable Energies Federation (EREF)

First step in attaining the goals is the characterization of the non-recyclable waste stream produced in the **M**aterials **R**ecovery **F**acility (MRF) of EPANA. This stream is called **R**efuse **D**erived **F**uel (RDF).

2 MRF of EPANA S.A.

EPANA S.A. operates a modern MRF in Ano Liosia, Attica, Greece:

- Annual capacity of the plant 100.000 tons
- Handles commercial, industrial waste - packaging waste streams,
- Recovery of recyclable materials of high purity - annually 70.000 tons of recyclables
- Remaining quantities (~15% w.t.) - mainly plastic and paper - used for Solid Recovered Fuel (SRF) production.

The material streams produced from the process are the following:

1. Large materials from the reception area
2. Unwanted materials from the pre-sorting cabin
3. Fine fraction (<65 mm) of the trommel screen
4. Residues from the overflow (>280 mm) of the trommel screen
5. Residues from the rest of the process.

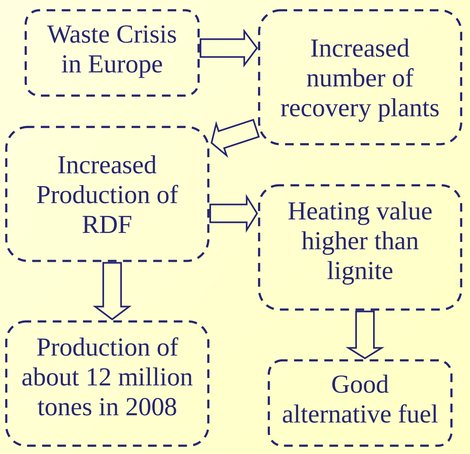
The non recyclable streams (4 and 5) are used for the production of RDF/SRF able to be utilized as fuel.

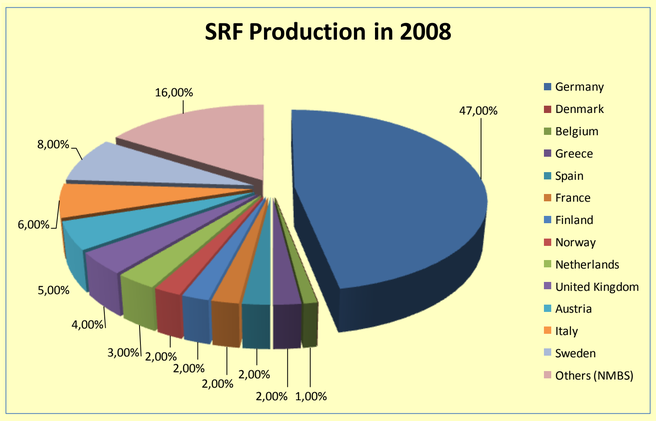
EPANA SA , Ano Liossia - MRF facility, external and internal view

RDF produced in EPANA SA

3a Refuse Derived Fuel

RDF production in Europe





(Source: European Recovered Fuel Organization)

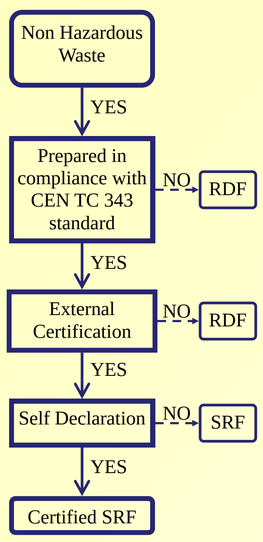
RDF characterization and classification following CEN/TC 343 standards

CEN/TC 343 is an emerging standard for:

1. characterization
2. classification of RDF/SRF

Standardization is considered as a key issue for:

- acceptance and trading in the energy markets.
- monitoring of key properties
- classification
- preliminary assessment of their combustion and environmental performance



For the standardization process, certain steps need to be followed including a series of analyses for the RDF in order to specify certain parameters mandatory for the classification. Specifications for the analyses, sampling campaign and classification are given in the framework of CEN/TC 343. After classification and self-declaration RDF is called **S**olid **R**ecovered **F**uel (SRF).

Classification, parameter	1	2	3	4	5
LCV, MJ/kg, (ar)	≥25	≥20	≥15	≥10	≥3
Cl, % wt (dry base)	≤0,2	≤0,6	≤1,0	≤1,5	≤3,0
Hg, mg/MJ, mean ,80th%	≤0,02 ≤0,04	≤0,03 ≤0,06	≤0,08 ≤0,16	≤0,15 ≤0,30	≤0,50 ≤0,10

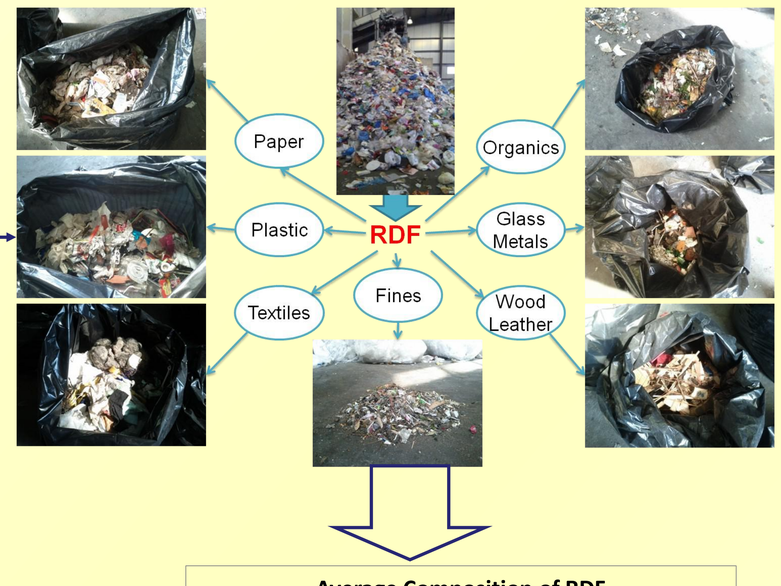
EPANA's RDF is sampled daily for the determination of physical and chemical properties and the classification following the CEN/TC 343. These properties are also used for the design of the thermochemical process of gasification.

3b RDF Analyses

RDF composition

Except plastic and paper, RDF contains other material

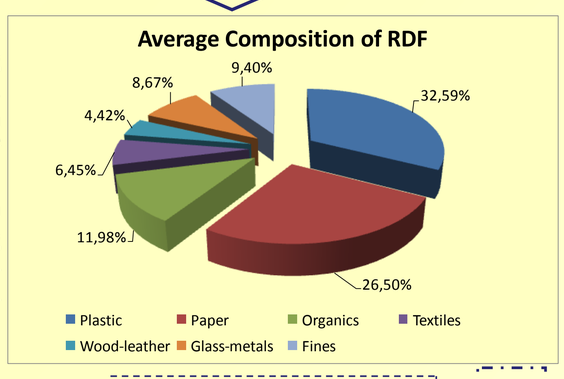
Two manual sorting campaigns for "contaminants" identification



Sampling Procedure

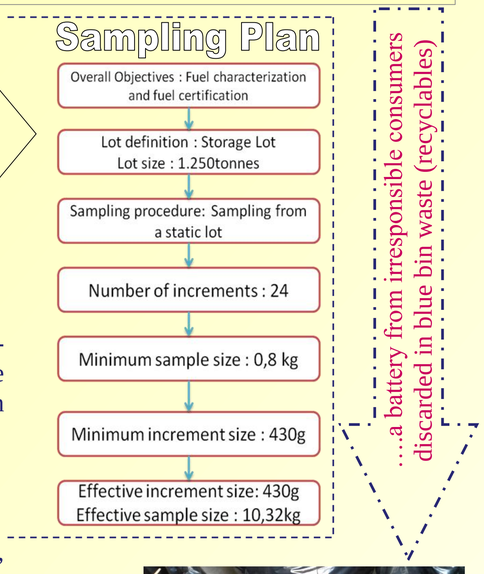
For the needs of fuel characterization a sampling methodology was defined according to CEN/TC 343. For normal operation the samples will represent data from a yearly operation, so as the whole variance of seasons will be covered.

According to the standard EN 15442:2011 certain parameters have to be specified before the beginning of the sampling procedure. These parameters presented below, are included in a standardized document called "sampling plan".



- Overall objectives
- Lot and lot size
- The sampling procedure
- The minimum number of increments
- The minimum sample size
- The minimum increment size
- The effective increment and effective sample size

Implementation of Sampling plan



Analyses

Target of the sampling procedure is the analysis and classification of RDF produced in EPANAs MRF. So far the analyses that were conducted are (The analyses took place in CERTH/ISFTA's laboratory):

- Proximate Analysis (Moisture, Ash, Volatiles, Char)
- Ultimate Analysis (C, H, N, S, O, Cl)
- Heating Value Analysis
- Heavy Metals Analysis (Sb, As, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Tl, V)

The following tables present the average results from eight months of sampling and analysis of EPANA's RDF while the figures to the right show the variance of proximate, heating value and chlorine analysis for the same period.

Proximate Analysis

	Average (% w.t.)	Standard Deviation
Moisture	26,72	6,99
Ash (as received)	8,39	2,47
Volatiles (as received)	60,01	5,18
Char (as received)	4,21	2,55

Ultimate Analysis

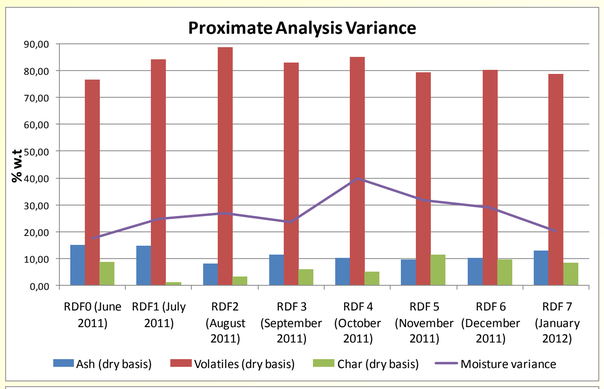
	Average (% w.t.)	Standard Deviation
C (d.a.f)	55,26	5,72
H (d.a.f)	7,21	1,10
N (d.a.f)	1,32	0,62
S (d.a.f)	0,25	0,19
O (d.a.f)	35,53	6,97
Cl (d.a.f)	0,43	0,19

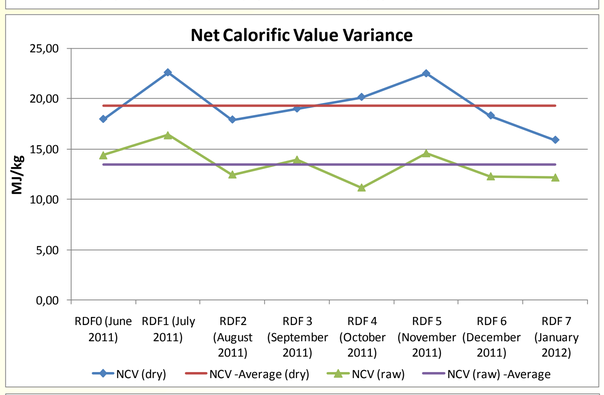
Heating Value Analysis

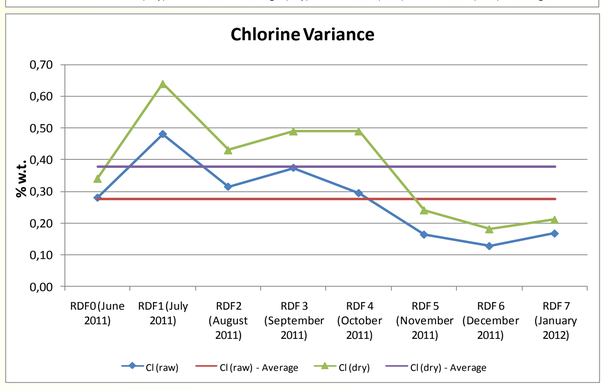
	Average	Standard Deviation
HHV (MJ/kg)	20,70	2,50
LHV (MJ/kg dry)	19,31	2,35
LHV (MJ/kg raw)	13,43	1,71

Heavy Metals

	Average	Standard Deviation
Cd (mg/kg dry)	5,63	3,11
Cr (mg/kg dry)	20,65	12,59
Co (mg/kg dry)	5,87	6,78
Cu (mg/kg dry)	76,25	67,24
Pb (mg/kg dry)	110,52	132,31
Mn (mg/kg dry)	54,64	30,56
Hg(mg/kg dry)	0,69	0,69
Ni (mg/kg dry)	23,49	15,07
Tl (mg/kg dry)	8,65	11,60







Acknowledgements for the Project LIFE09 ENERGYWASTE

E.C.
http://ec.europa.eu/environment/life/index.htm

EP.AN.A. S.A.
http://www.epana.com.gr/

CE.R.T.H. / I.S.F.T.A.
http://www.lignite.gr/

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