Integrating Energy Recovery Into Solid Waste Management Systems

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Solid Recovered Fuels production and use in Europe

Giovanni Ciceri, Giovanna Martignon
RSE-SpA, Via Raffaele Rubattino 54 - 20134 Milan, Italy
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RDF and SRF: what’s the difference

**RDF** is a waste included in the EU Waste Catalogue, deriving from Mechanical and Biological Treatment (**MTB**)

| 19 12 wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified |
| 19 12 01 paper and cardboard |
| 19 12 02 ferrous metal |
| 19 12 03 non-ferrous metal |
| 19 12 04 plastic and rubber |
| 19 12 05 glass |
| 19 12 06* wood containing dangerous substances |
| 19 12 07 wood other than that mentioned in 19 12 06 |
| 19 12 08 textiles |
| 19 12 09 minerals (for example sand, stones) |

**NO SPECIFICATIONS**

**Composting & drying losses** 24%  
**Landfilled residue** 25%  
**RDF** 46%

Data from 15 MBT facilities in Germany 2001/2010  
(Ketelsen, 2012)
RDF and SRF: what’s the difference

Solid Recovered Fuels (SRF) are prepared from non-hazardous waste, including Municipal Solid Waste (MSW), through Mechanical and Biological Treatment techniques (MBT)

SRF is produced according a Quality Management System (QMS) given in EN 15358 SRF - Quality management systems - Particular requirements for their application to the production of solid recovered fuels and must comply with the specifications given in EN 15359 “SRF - Specifications and classes”
**RDF and SRF: what’s the difference**

**SRF** are then only a part are of **RDF**

SRF has a **classification and specification** system, the latter agreed by the producer and user, that ensure compatibility with the use in EfW or in co-combustion plants (coal fired power plants or cement kilns).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Classes</th>
<th>Limit value (mg/kg dry basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>LCV</td>
<td>MJ/kg (wet basis)</td>
<td>≥ 25 ≥ 20 ≥ 15 ≥ 10 ≥ 3</td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td>% (dry basis)</td>
<td>≤ 0.2 ≤ 0.6 ≤ 1.0 ≤ 1.5 ≤ 3</td>
<td></td>
</tr>
<tr>
<td>Hg</td>
<td>mg/MJ (wet basis)</td>
<td>≤ 0.02 ≤ 0.03 ≤ 0.08 ≤ 0.15 ≤ 0.50</td>
<td></td>
</tr>
</tbody>
</table>
RDF and SRF: different interpretations make confusion....

In Countries where a classification and specification system has been in force before the introduction of the EU standards (e.g. Italy), the term RDF and SRF are synonymous. The consequence is that only SRF can be classified as EWC 191210, all the other fractions deriving from a MBT plant (although combustible) must be classified as EWC 191212. No matter about the nature of the original waste (MSW or C&I).

In UK both EWC 191210 (Combustible waste – Refuse Derived Fuel) and EWC 191212 are used for RDF and rejects from MRF (Materials Recycling Facility) operations, but also for SRF.

In Ireland, the exported RDF is classified as EWC 20 03 01 Mixed Municipal Waste. This because most RDF producers stated that they undertook the minimum level of treatment to allow their waste to be legally exported.
MTB plant in Europe and SRF production - an overview

Capacity and number of MTB plants in Europe in 2010 (Various sources)

SRF production and number of plants in Europe (Source ERFO: 2010 data (Austria, France and Spain 2011; Poland and UK 2009)

The number on the bar refers to the number of operating plants.
SRF production and use in Europe - an overview

SRF use - Source: ERFO website/Fact & Figures
SRF production and use in Europe - an overview

EU Cement Sector Thermal Substitution Rate (2012)
Waste Source

It is not wholly clear whether the source of the RDF or SRF is from a MSW or C&I. It is assumed that SRF is from C&I sources and RDF is from MSW sources. Using these assumptions shows the following:

**RDF** is a crude “fuel” typically derived from Municipal Solid Waste (MSW) or commercial and industrial waste with similar properties to MSW with a Net CV (Calorific Value) of 8-14 MJ/kg
It is typically pre-sorted and shredded residual waste with recyclates removed where practical, or the reject fraction of a MRF (Materials Recycling Facility) operation

**SRF** is produced according to the classification and specifications set out in EN15359
It is typically derived from pre-sorted commercial & industrial (C&I) waste or rejects from MRF activities, but also from MSW, and typically has a Net CV >15 MJ/kg
RDF/SRF production and use – focus on UK

Size of the Market

Source: DEFRA - Refuse derived fuel market in England Call for evidence March 2014 (2009 data from ERFO website)

| Source: AMEC Environment & Infrastructure UK Limited, July 2013 (2011 and 2012 data) |

<table>
<thead>
<tr>
<th>RDF/SRF (kt)</th>
<th>RDF/SRF (% of the total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td></td>
</tr>
<tr>
<td>Domestic EfW</td>
<td></td>
</tr>
</tbody>
</table>

| Source: AMEC Environment & Infrastructure UK Limited, July 2013 (2011 and 2012 data) |

<table>
<thead>
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<th>Size of The Market</th>
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</table>

| Total MSW 2011   | 42.6 |
| Total C&I 2011  | 59.9 |
| Residual once Recycling Targets met in 2026 | 43.5 |
| Potential RDF/SRF Production (Mte) (60% of Residual) | 26.1 |
Export as a business?

Export of RDF and SRF has become prevalent particularly from England, Scotland and Ireland.

The main reason is financial, driven by the increasing cost of landfill (tax) in the UK and Ireland.

It is relatively easy to produce RDF and relatively easy to export.

SRF production is becoming more about producing a quality fuel with a market value, but the availability of suitable plants is limited and highly dependent on the cement industry, with only a few cement kilns and power plants in Europe accepting SRF.
Exports of RDF/SRF – focus on UK

Source: DEFRA - Refuse derived fuel market in England Call for evidence - March 2014 (2009 data from ERFO website)
Exports of RDF/SRF – focus on UK

Export of RDF/SRF from UK

Source: AMEC Environment & Infrastructure UK Limited, July 2013 (2011 and 2012 data)
Exports of RDF/SRF – focus on UK

Export of RDF and SRF from England to EU Countries

Sources:
AMEC Environment & Infrastructure UK Limited, July 2013 (2011 and 2012 data)
Kathryn Warren (Ricardo AEA) – IEA Bioenergy task 36 “Opportunities for SRF in a Circular Economy – Encouraging member states” – Brussels 22nd April 2015
RDF/SRF - preparation and shipment and recovery costs – focus on UK

Average “all in” cost for preparing residual waste into RDF and for shipment and recovery to Netherlands and mainland Europe from UK/Ireland (€ per tonne) …… shipment and recovery roughly broken down as follows

Source: AMEC Environment & Infrastructure UK Limited, July 2013 (2011 and 2012 data)
SRF production and use – focus on Italy

Size of the Market – Waste production in Italy in 2013

- **SRF (19 12 10):**
  - 1.21 Mton from MSW + 0.27 Mton from C&I

- **RDF (19 12 12 or “dry fraction”):**
  - 3.61 Mton from MSW + 1.8 Mton from C&I

- Residual MSW + rejects from MTB plants:
  - 51.6 Mton

- Potential RDF/SRF:
  - 31.0 Mton

*Source: ISPRA*
SRF production and use – focus on Italy
The MSW-M&MBT network

Capacity and total input of MSW-M&MBT plants in Mton/a
The number on the bar refers to the number of operating plants

Source: ISPRA
SRF production and use – focus on Italy
The MSW-M&MBT network: Plant INPUT

The Whole Network

MSW-M&MBT Plants with SRF production

Source: ISPRA
SRF production and use – focus on Italy

The MSW-M&MBT network: Plant OUTPUT

The Whole Network

MSW-M&MBT Plants with SRF production

OUTPUT composition

<table>
<thead>
<tr>
<th>Year</th>
<th>Liquid waste</th>
<th>Materials</th>
<th>Not Composted Organic Fr.</th>
<th>Humid Fr.</th>
<th>Residue &amp; Solid Waste</th>
<th>Biostabilized Fr.</th>
<th>Driedried Fr.</th>
<th>Dry Fr.</th>
<th>SRF 12 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1,072,534</td>
<td>32,453</td>
<td>383,346</td>
<td>1,152,284</td>
<td>11,094,906</td>
<td>120,7126</td>
<td>1,026,557</td>
<td>1,207,126</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1,094,906</td>
<td>32,523</td>
<td>384,346</td>
<td>1,152,284</td>
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<td></td>
</tr>
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Source: ISPRA
SRF production and use – focus on Italy

The MSW-M&MBT network: Final Destination of the Total OUTPUT

The Whole Network

MSW-M&MBT Plants with SRF production

Final destinations of the Total PLANT OUTPUT

- Waste water treatment
- Storage
- Landfilling
- Material recovery
- Biostabilization
- SRF production
- Energy recovery
- Incineration

Source: ISPRA
SRF production and use – focus on Italy

MSW-M&MBT: Final Destination of 19 12 10 and 19 12 12 (Dry Fr.)

Source: ISPRA
SRF production and use – focus on Italy
The C&I-B&FC (D8-D9) network

Source: ISPRA
SRF production and use – focus on Italy

SRF National destination: Incineration (ton/a)

Incineration - MSW WtE Plants

Source: ISPRA
SRF production and use – focus on Italy

SRF National destination: Energy Recovery

![Graph showing SRF production and use in Italy]

Source: ISPRA; AITEC; ENEL
SRF production and use – focus on Italy

OUTPUT from MSW-M&MBT: EXPORTS

Source: ISPRA
E.O.W. of SRF in Italy in a glance

SRF Classification: UNI EN 15359 and EoW Italian Regulations Decree 22/2013

Production:
Only particular CER are admitted and there are limits on
The efficiency of the process
Production plants and processes admitted
The producer shall adopt a quality management system according to UNI EN 15358, or EMAS
Declaration of conformity
SRF ceases to be classified as waste upon issue of the “declaration of conformity containing the data identifying the user (max storage period: 6 month)

European contest:
The Italian EoW criteria is valid only to within the Italian borders

Utilisation:
1. CEMENT PLANTS with capacity > 500 t/d of clinker
2. THERMAL POWER PLANTS with heat rating > 50 MWt
Obligatory for both categories: Authorization (according to Dir IED) and UNI EN ISO 14001 or EMAS
Stack Emissions Limits for Co - incineration limits (Dir IED): for cement plants: 500 mg/Nm³ NOₓ, etc... derogations for CO and SO₂

<table>
<thead>
<tr>
<th>Parameters</th>
<th>LIMIT mg/kg s.s.</th>
</tr>
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<tbody>
<tr>
<td>Antimony (Sb)</td>
<td>50</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>5</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>4</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>100</td>
</tr>
<tr>
<td>Cobalt (Co)</td>
<td>18</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>250</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>30</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>250</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>500</td>
</tr>
<tr>
<td>Thallium (Tl)</td>
<td>5</td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td>10</td>
</tr>
</tbody>
</table>

EUROPEAN EN 15359 (Annex A, Part 1): Obligatory to specify in supplying (by Producers), but no limits are fixed... it's up to commercial agreements.
ITALY End Of Waste decree: obligatory to specify and limits fixed for each parameter
Limits have been agreed with producers, users and public institutions.
SRF are then only a part of RDF…… and E.O.W – SRF are only a part of SRF
Problems

• The capacity for SRF treatment has not kept up with SRF production
• Production remains static in some countries because of over capacity in EfW facilities
• Too much competition from RDF in EfW facilities (incineration and co-incineration) in many European countries

Possible solutions

• Conversion of SRF in to syngas or liquid fuels, chemical commodities, but this requires a high quality SRF
• Improve standardization of acceptance criteria and specifications for SRF use by CEN TC 343 “Solid Recovered Fuels”
• Need further legislation for landfill bans at EU and Country level
• EU Funding for the development of SRF treatment in newer member states
Thank you!

giovanni.ciceri@rse-web.it