Solid recovered fuel offers new possibilities for fuel briquette manufacturers

**Briquetting solid waste**

The European Waste Directive set targets for each EU member country to reduce the mass of waste consigned to landfill. Encouraged by regulation and the landfill tax, UK waste producers and processors were motivated to “reduce, reuse, and recycle”. Processing technology has enabled waste pre-treatment and recovery of aggregates, glass, metals, plastic, paper, and cardboard. The three R’s were extended to include “recovery” — namely energy recovery by incineration of the residual waste, but UK waste processors are at a disadvantage as there are insufficient local incinerators.

The alternative was the growing demand for refuse-derived fuel (RDF) from UK’s European and Scandinavian neighbours, who embraced RDF as a reliable source of green energy and revenue. RDF is made from domestic waste which includes biodegradable material as well as plastics, and has a lower calorific value than solid recovered fuel (SRF). RDF is used in energy-from-waste plants. SRF is a refined form of RDF.

Multiple investments throughout northern Europe created an overcapacity of combined heat and power (CHP) plants but a shortage of reliable fuel. This is the reason why UK waste processors have found a ready market for around 2 million tonnes of RDF at a cost of upwards of £60 ($77) per tonne.

There has been an increased focus in using secondary biomass for energy. This is because the UK has renewable energy targets to meet and the use of RDF/SRF, although not wholly renewable, can contribute to these targets. In fact, the UK has to obtain 15% of its energy from renewable sources by 2020.

In 2011 the UK government introduced an environmental programme to provide financial incentives to increase the uptake of renewable heat. This is called the Renewable Heat Incentive (RHI). It provides financial support to non-domestic renewable heat generators and producers of biomethane. Only municipal solid waste (MSW), including SRF with less than 10% fossil fuel, and wastes which are at least 90% biomass are eligible (except for anaerobic digestion) for the subsidy. Obtaining incentives for heat increases the profitability of using secondary biomass for non-conforming materials. Domestic general waste is best suited for waste pre-treatment (recycling), with the residue forming RDF.

**Solid recovered fuel**

SRF differs from RDF in the major aspect that there is a European standard (CEN/TC 343) for it. SRF is produced from non-hazardous waste in compliance with the European standard EN 15359 and requires the producer to test the net calorific value, chlorine, and heavy metals indicated in the Industrial Emissions Directive. It is important to note that standards do not state quality levels, and it is the end user who defines the specification for density, particle size, moisture level, chemical composition, and energy content of the fuel. The principle UK users of SRF are cement manufacturers who utilise SRF as a secondary fuel and benefit from the gate fee revenue. Gate fees for SRF reflect the increased cost of heat generation and this is helping the SRF industry. Unregulated waste producers, including domestic households, form around 40% of UK waste. Local authority guidance has encouraged households to segregate recyclables and green waste, but the residual general domestic waste contains high levels of moisture and is invariably contaminated with

A finished briquette produced from solid recovered fuel (SRF)
processing and are generally much lower than for RDF, typically £30 per tonne.

The SRF standard is more easily achieved if the source and composition of the incoming waste is known. Regulated waste producers, industrial and commercial sources, must segregate hazardous waste and accurately describe the composition of the non-hazardous waste. Thus, non-hazardous waste from regulated industrial producers is consistent, contains less moisture and contamination, and is more attractive to waste processors seeking to produce conforming SRF. SRF is produced on a just-in-time basis. Simple quality control procedures are built into the process.

Pre-treated waste residue (post-recycling) is visually inspected before shredding to 200mm particle size. The material is then passed through over-band magnets, eddy current separators, and wind sifters to remove non-conforming material prior to final shredding to 20mm. It is finally passed over a grading screen to remove fines. Samples of the end product are assessed for moisture content and cumulative samples sent for laboratory analysis to confirm adherence to the specification. These results can be plotted to monitor trends in the source material and even seasonal effects.

The waste processor must shift the SRF quickly to the end user to minimise storage space and mitigate risk. Transport is typically by sheeted 100m³ ejection trailers filled by 10m³ bucket loader. Uncompressed, the SRF has a density of around 110-130kg/m³.

**Briquette manufacture trial**

UK energy producer Warwick Energy conducted a six-month briquetting trial using a pair of CF Nielsen BP3200 presses. CF Nielsen is a manufacturer of briquetting equipment recommended for maximum raw material moisture content of 16%. The manufacturing trial verified the optimum SRF moisture content of 14-15%, with the moisture content of finished briquettes being typically around 10%. Further tests of stored briquettes observed the moisture content continued to drop to 8%.

Warwick Energy’s test was based primarily on SRF producing briquettes with small diameters (40 mm). In general, CF Nielsen has found that SRF is a difficult raw material to densify, with higher opex and capex costs than normal biomass. It is C.F. Nielsen’s recommendation that SRF should be mixed with another raw material such as demolition wood, as this will increase the capacity of the machines and lower the costs. Increasing the diameter to 60 mm will increase capacity even more and thus result in a good investment.

During the test the SRF was compressed through a die to extrude a continuous length of material. The die is smaller than the required finished diameter, as the emerging hot material expands as it exits the die. The pressure and the heat is adjusted to ensure adhesion of the particles and density of the extruded material. Typical processing temperature was 180-190°C and the extruded SRF was cooled prior to breaking to finished length. The optimum briquette length is typically three to four times the diameter.

SRF moisture is the key issue. Moisture above the stated limits invariably leads to unstable extrusion. Die wear is significantly improved when abrasive metal and aggregate fines are minimised. Consistent SRF particle size enables the breaking of regular length briquettes. A known volume of finished briquettes was weighed to determine the density. Warwick’s specification for finished briquettes was 550-565kg/m³. Improvements to the wind sifter during the course of the trial contributed considerably to the production of consistent briquettes.

The significant characteristics of the briquettes are the increased energy content attributable to the reduced moisture and the increased density, compared to normal SRF. Other benefits included reduced odour, assumed to be the result of the process heat eliminating bacterial activity. Briquettes exposed to the weather remained robust. When wetted, they were found to not absorb moisture and briquettes subjected to robustness test reported losses of 5%. An uncontrolled test noted negligible avian or vermin activity.

The briquettes performed as predicted in the gasifier. The flow of the fuel was easy to control and the syngas generated met expectations. The briquettes remained stable following loading by 10m³ bucket, transport in 50m³ trailer, and off-loading by conveyor belt with minimal losses of fines.

Although there is considerable investment in briquetting equipment and energy to produce briquettes, the outcome is a high energy, robust fuel that is readily transportable, storable, and simple to handle.