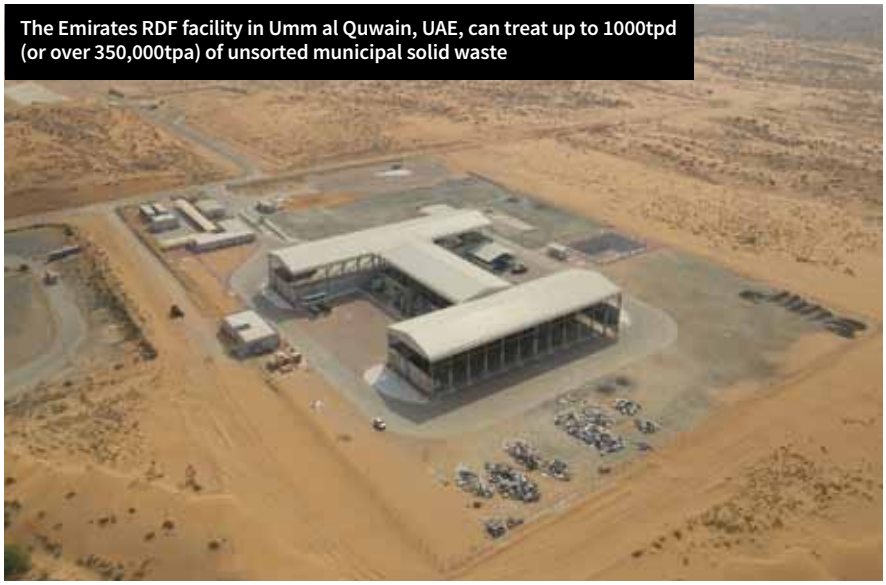
Waste to fuel for the UAE

The Emirates RDF production plant in Umm al Quwain, UAE, has received much attention since its launch. Designed to power the local cement industry with refuse-derived fuel (RDF), Jori Kaaresmaa, senior process specialist at BMH Technology Oy, speaks to ICR about the development and process behind the facility, and the sustainable opportunities for other cement producers in the Gulf region and beyond.

■ *by **ICR Research**, UK*

ICR: What is the main history of BMH Technology and its work within the waste recycling sector?
Jori Kaaresmaa (JK): Established in 1929, BMH Technology has a long history of working with material handling solutions. The company's traditional business in wood-based biomass handling has been with the energy sector as well as pulp and paper mills.

At the turn of the century, BMH developed its SRF/RDF [solid recovered fuel/refuse-derived fuel] production technology and launched the TYRANNOSAURUS® Shredder. Since then, BMH Technology has delivered dozens of waste refining plants globally and become one of the global leaders in industrial-scale waste refining technology.

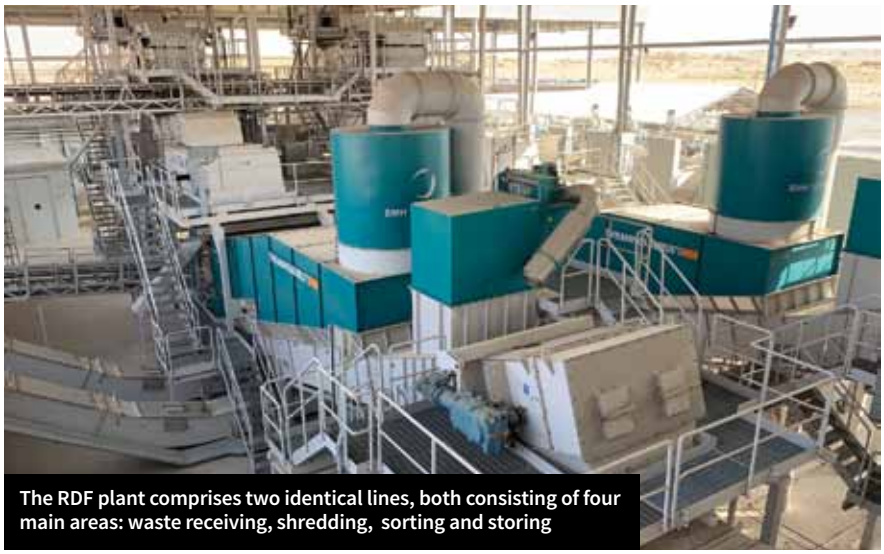


The Emirates RDF facility in Umm al Quwain, UAE, can treat up to 1000tpd (or over 350,000tpa) of unsorted municipal solid waste

ICR: How is the company set up to work with the cement sector (and suppliers to the cement sector)?
JK: In the cement sector BMH mainly acts as a technology supplier for SRF production facilities. BMH is also a professional in alternative fuel receiving, handling, storing and feeding systems, so these solutions are also available in the cement sector.

Even before creating its own SRF production technology, BMH's history lies with solid fuel (SRF, RDF, wood chips, bark and other types of biomass) processing and handling systems in the power sector where these solid fuels are considered not as alternative fuels but as primary fuels that require robust, reliable and high-capacity solutions.

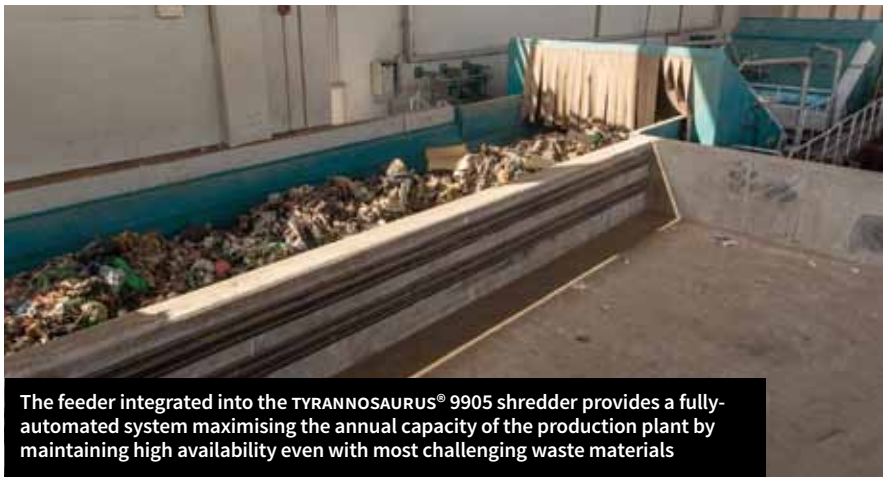
Because we have applied the same technical solutions in the cement sector our systems are most attractive in the applications where high capacities are handled and where reliability plays a key role.



The RDF plant comprises two identical lines, both consisting of four main areas: waste receiving, shredding, sorting and storing

Emirates RDF project, UAE

ICR: When BMH Technology was approached to design and construct the Emirates RDF factory in the UAE how difficult was it to determine the scale of the facility and the equipment needed?
JK: Development and design of such a plant always starts from defining the waste source, amount and quality, as well as the fuel specification(s) of the off-taker(s). A certain amount of waste is typically given by an authority/municipality/etc, but securing the quality of that waste is most often a challenge. Waste studies from the region are often available. Additionally, BMH can offer support by carrying out a waste study to define the exact composition. However, to set up a waste



The feeder integrated into the TYRANNOSAURUS® 9905 shredder provides a fully-automated system maximising the annual capacity of the production plant by maintaining high availability even with most challenging waste materials

composition for the basis of the design is always a challenge. This is because, in reality, each waste batch is somehow different: seasonal changes have an impact on the waste quality and consumer behaviour changes over the years (or decades even) – which again reflects on the waste composition. All these points had to be carefully measured, estimated and calculated.

Once the waste composition was in place, we were given the RDF specification, which was the result of various discussions with local cement companies. Generally, it is relatively easy to reach almost any specification, but to do so economically is a challenge. Moreover, most often the recovery rate (the limitation of how much material is allowed to be rejected by the process) is one of the key drivers in a project. This was also the case in this project: the authorities required a strict guarantee limit on how much material would be allowed to be landfilled after processing.

In the case of Emirates RDF, we mutually agreed the design parameters, namely the waste composition, processing capacity and the specification and yield of the produced RDF (ie, particle size, calorific value, moisture and the maximum content of certain contaminants). Knowing the fluctuations in day-to-day waste composition and the fact that the waste management company wanted to be able to process various waste types, one of the important aspects was to design a process that would be flexible and easily adjusted.

ICR: Was much known about the availability of municipal solid waste (MSW) for RDF in the region?
JK: The availability and amount of waste is guaranteed by the authorities. Knowing that the waste quality and amount will most probably change in the long run, flexibility (for example, online process adjustments) and the possibility to easily expand the system in the future were important design parameters.

ICR: Which companies collaborated in the project?
JK: The project was developed by Griffin Refineries and BESIX. The facility was built and managed through a public-private-partnership arrangement with a BOT (build – operate – transfer) scheme. The partners are the Ministry of Climate Change and Environment (MOCCAE) of the Emirate of Umm Al Quwain and the Emirates RDF company. Emirates RDF is a joint venture between BESIX, the Ajman-based Tech Group Eco Single Owner holding company, and Griffin Refineries.

Process from start to finish

ICR: How does the process work from start to finish at the Emirates facility?
JK: The process comprises two identical lines, both of which consist of four key areas: waste reception, shredding, sorting and storing. All these areas are housed under one roofed building containing half walls. There are also ventilated and/or air-conditioned rooms with electrical cabinets, hydraulic power packs and spare parts.

While the operator monitors and manages the plant from the control room, it is also possible to do so from local control desks. Staff have dedicated roles in loading the MSW into the process, managing the side streams and RDF, as well as carrying out tasks according to a preventive maintenance programme.

The MSW arrives at the plant by truck. Each batch is weighed before being delivered to the reception hall. The material is tipped onto the floor for a visual check and then either moved directly to the process or to the raw waste buffer storage section. At this stage, the operator is able to remove waste items that may affect the process or contaminate the RDF (such as gas bottles and car batteries).

A front loader loads the MSW into the process. The bucket is emptied on the TYRANNOSAURUS feeder which then doses the waste into the process.

The MSW waste is shredded to a predefined particle size in one single shredding stage by the TYRANNOSAURUS® 9905 shredders. Each unit has a peak throughput capacity of 50tph when producing an average material size of approximately 40-50mm. The produced particle size is primarily optimised to meet cement producer requirements. However, a constant and even flow of small particle sizes also contributes to high accuracy sorting in the subsequent stages of the process.

The feeder integrated into the TYRANNOSAURUS 9905 shredder is fully automated, which maximises capacity by maintaining high availability – even when dealing with the most challenging waste materials. The shredder constantly communicates with the feeder and the plant control system to ensure the optimum feeding of material into the shredder.

Feeding is an important factor for capacity. Insufficient feeding means the machine only utilises a portion of the full capacity. On the other hand, too much feeding can result in blockages.

The waste is shredded to a predefined particle size in one single shredding stage by the TYRANNOSAURUS 9905 shredders

The material bed height in the shredder is measured and the information is used to optimise the feed rate. The intelligent pusher inside the shredder controls the capacity between the feeder cycles, maintaining a constant load on the rotor and maximising capacity.

The ZeroGap® feature ensures that the capacity of the shredder remains high, even with worn knives. The distance of the rotor knives and the counter knives is adjusted semi-automatically during daily inspection. Thanks to this feature the thinnest materials, such as plastic foils, are shredded. The sharp cutting profile achieved by the ZeroGap also minimises power consumption in this power-intensive phase of the process.

The Massive Impact Protection System (MIPS®) protects the shredder from damage caused by items that are unshreddable. Therefore, unexpected downtime caused by unshreddable items can be avoided, ensuring high availability and higher capacity.

After exiting the shredder, the material is transported through a two-stage metal separation station. Stage one removes ferrous metals from the waste stream with a strong electrical magnet. Non-ferrous metals are then separated efficiently with an eddy current separator. The separation efficiency and purity of the ferrous and non-ferrous metals is high due to the small particle size of the material stream. Recovered metals are sold to be recycled and refined.

A fines screen is used to reduce the content of sand, soil, dust, glass splinters as well as other small inert materials in the RDF. The separation rate can be adjusted from the control room based on the fines content in the MSW and the ash limit of the RDF specification. Rejected fine materials are mainly free of organic content and are often used as inert filling material.

The material then enters the air classifier that separates out three types of fractions: heavy, middle and light. Separation is based on the aerodynamic properties of the particles when they enter a strong airstream. The lighter particles are carried further away than the heavier particles. The customer can adjust the quality of the fuel as needed. The air classifier can be adjusted by damping the fan or reducing its speed of rotation, or by adjusting the position of a dividing roller and the collecting conveyor inside the air classifier. The heavy fraction rejects from the air classifier are high-density particles (eg, stones, soil, glass, pieces of brick and residual metals).

After the sorting process, the RDF – now free of the heavy-fraction rejects – is discharged into the storage area. This part of the building contains six large bunkers which the operator can fill by selecting the desired bunker from the control system. This flexible system also allows different types of RDF to be stored (eg, different cement plants have different RDF specifications). The RDF types can be produced by changing the settings of the production line, then the produced RDF can be stored in the dedicated bunker. There may also be times when special wastes need to be processed.

Finally, front loaders move the desired material from the selected bunker to a truck for delivery to the cement plant.

ICR: Is the TYRANNOSAURUS 9905 used at Umm Al Quwain a standard model, or has it been specially adapted in any way?
JK: There are few parameters in each delivered T9905 unit that we always adjust according to local requirements. Otherwise, both T9905 units at Umm Al Quwain are of standard design.

ICR: What kind of targets had to be reached to make the plant successful and meet the needs of the local cement industry in term of reducing coal usage?
JK: To reach the targets the MOCCAE, together with Ajman and Umm al Quwain municipalities, set high requirements for the performance of the plant. The system is designed to process 1000tpd of unsorted MSW (or over 350,000tpa), converting more than 80 per cent of it into RDF that fulfils the requirements of the domestic cement industry. In practice, this means production of 800tpd of fuel that can replace some 500t of coal used by cement plants. The particle size of this fuel must be constant but also small enough to allow rapid and complete combustion in the calciner, and to allow as many cement plants as possible to apply this AF without major modifications.

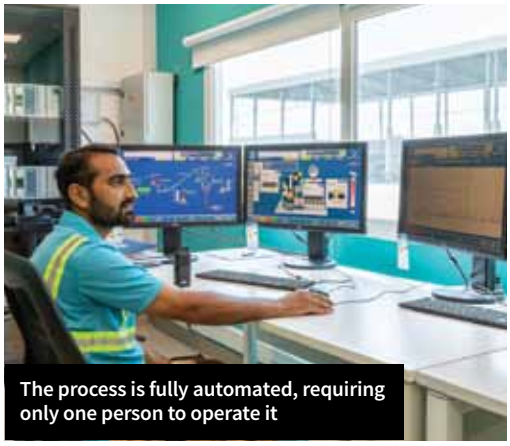
ICR: How important is the particle size achieved and the calorific value (CV) of the produced RDF?
JK: These parameters are extremely important when producing the fuel that substitutes coal in cement sector. Generally, most cement plants that use alternative fuels and raw materials (AFR) do so for improved financial and environmental performance. To reach these targets, the size and CV of the AFR should generally be at a level where (with a good handling system and quality control, coupled with calciner and kiln burner optimisation) it could be combusted as a prime fuel – this means 100 per cent burn-out, no CO or VOCs and the same level of calcination.

ICR: What can you tell us about how the plant is controlled and automated? Is it highly optimised with digital technology?
JK: The process is fully automised and basically requires only one person to operate it. The operator carries out his work in a control room where he can monitor operations through PC screens that are connected to the control system, and that provide a video image through various cameras installed within the process.

From the control room the operator can adjust the process parameters according to the input waste quality and the RDF output specification. He can also choose the correct storage box for different RDF qualities.

Some process adjustments take place without any user/operator input. For example, the shredders can automatically

The particle size of the fuel must be small enough to allow rapid and complete combustion in the calciner and allow as many cement plants as possible to use the alternative fuel without major modifications


The process is fully automated, requiring only one person to operate it

detect the quality of the processed material and adjust the operation mode. Also, when the waste contains an unshreddable object (such as large stone or a bigger piece of steel) it automatically detects the object, removes it from the process and continues operation.

The plant is also equipped with spark detection and an extinguisher system to prevent fires and dust explosions. Additionally, the system includes automatic dust control units to prevent dust generation to the surrounding atmosphere. These systems also communicate with the control system.

ICR: How is the RDF stored to keep it in peak condition with controlled moisture levels?
JK: The idea is not to store big amounts of RDF in this facility. Rather, the target is to transport RDF to the consumers as soon as possible. For the short term RDF is stored in open box-type storage from which it can be easily loaded in the truck trailers for transportation.

The storage area is fully covered to protect the RDF from possible rainwater. If longer-term storage is required in the future, the layout has a reservation for a baling and wrapping unit.

Engaging with RDF

ICR: What are the main challenges in getting more cement producers to engage with RDF and using waste as an alternative fuel in the Gulf region?
JK: The main challenges are:

- Process concerns: a cement plant is not necessarily easy to operate and changing the fuel policy requires lots of know-how and attention. Additionally, each plant is different, so one cannot trust that what works with the neighbour works with me. However, there is a lot of knowledge available (also through BMH's network) and references about how to do it – requiring EXCO level commitment and pressure.
- Economic concerns: generally, the AFR cost should be the same or lower than the cost of using fossil fuels. Low (or zero) gate/tipping fees together with low fossil fuel prices make an investment unattractive. By increasing the disposal costs (gate/tipping fee) governments can make it attractive to supply good quality AFR at an attractive price.

RDF market trends

ICR: What are the opportunities for other cement producers in the Gulf region and what economic case can be made for using alternative fuels instead of fossil fuels?
JK: The opportunities are huge. The waste is available, the technology is well-proven, and basically any process issue can be solved.

ICR: To what extent has the global shift towards decarbonisation impacted the AF market?
JK: Generally, the decarbonisation trend should boost the AF market. However, this question has many dimensions and sometimes even the cement companies are confused whether they should change the fuel policy and in what direction. For example:

- how should the fossil CO_2 content of AFR be defined?
- impact of taxonomy
- can AFR usage in cement production be considered (partly) as chemical recycling?

ICR: The success of the UAE project is attracting much attention. What can you tell us about the order for a TYRANNOSAURUS® FineScreen and Air Classifier in South Korea?
JK: BMH Technology has just recently delivered three waste shredding lines to SsangYong C&E's plants in Donghae and YeongWol in South Korea. The lines produce high-quality SRF to kilns used in cement production. Using SRF decreases the use of fossil fuels and increases material recovery.

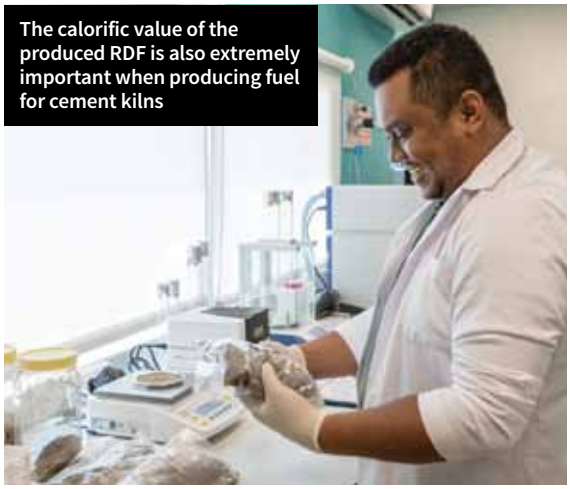
Each line includes a TYRANNOSAURUS FineScreen and a TYRANNOSAURUS Air Classifier for separating impurities. Altogether, the delivery contains five TYRANNOSAURUS FineShredders with exceptionally high capacity.

Donghae is one of the world's largest SRF shredding plants producing alternative fuel for the cement industry. With a total of two lines and four shredders, the capacity of the Donghae plant is 80tph producing a particle size of under 25mm.

Going forward

ICR: What are the goals and ongoing projects for BMH Technology in 2022?
JK: In 2022, BMH Technology is supplying two large biomass handling systems for big new boilers in Finland of 220MWh each (in Helsinki and Tampere). We will also deliver a large feedstock handling plant for a waste-to-chemicals refinery in Canada. In Asia we are supplying a comprehensive waste-to-fuel plant to Taiwan. BMH continues strengthening its position as a leading global supplier of major size waste and biomass processing plants for the production of renewable fuel and feedstock for chemical recycling.

ICR: How will the current trend in fossil fuel price inflation impact demand and pricing for RDF, both in local and international markets?
JK: While increased fuel prices make SRF more attractive, the use of SRF in any cement group/company needs to be part of a core business designed to help the local waste disposal issue, which also gives both financial and environmental benefits to the group/company. It is a long-term commitment not really impacted by short term market fluctuations in fuel prices. ■


The calorific value of the produced RDF is also extremely important when producing fuel for cement kilns