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Alternative opportunities

by Tariq Majid Khan Niazi, Jebel Ali Sewage Treatment plant, UAE

Doubling of capacity at the Jebel Ali Sewage Treatment plant in Dubai, UAE, offers domestic cement producers the potential to use excess sludge from the process as an alternative fuel source. The move would not only allow the cement industry to scale down reliance on traditional fuels and, therefore, reduce GHG emissions but also tackle the problem of how to safely dispose of sewage sludge in an eco-friendly manner.

The Jebel Ali Sewage Treatment Plant, situated close to Dubai's Al Maktoum International Airport, has been established to treat wastewater from the city's rapidly-developing new housing and industrial areas. The first two phases of the build were completed in 2009 to treat 300,000m³ of sewage water, but plans have been put in place by Hussain Nasser Lootah, director general of Dubai Municipality, and Abdul Aziz Najam, director of Dubai's Sewage Treatment department, to establish another plant of equal size, parallel to the existing facility.

After water is treated (see panel) the effluent is supplied for agricultural and domestic use in Dubai. The byproduct after treatment of wastewater produces 140m³/h of sludge cake with a 20-24 per cent dry-solids quality from one centrifuge (with four centrifuges in total). After the centrifuge, the sludge is processed in dryers, two of which are in operation while one remains on standby. The mass feed flow rate capacity of each dryer is 327tpd.

After the dryer stage, sludge material is carried by a blower to the dry product silo. This end product, manure, is used as a fertiliser for horticultural purposes. From the silo, the manure is automatically packaged and around 1500 units per day can be filled in 25kg bags. Excess quantities of sludge are filled into dumpers and sent to landfill.

Fuel opportunities

However, a far more sustainable option for this excess sludge is to use it as alternative fuel source in cement production. Due to high kiln temperatures, the organic content of the sewage sludge is completely destroyed. The sludge minerals will be bound in the clinker after the burning process.

The calorific value of sewage sludge depends on the organic and moisture content of the sludge. Dried sewage sludge has a high organic material content (40-45wt percentage) and possesses a high calorific value. Waste from a sewage sludge treatment plant plays a minor role as a raw material subsititute due to its chemical composition.



Jebel Ali Sewage Treatment Plant, Dubai, is soon to see another plant of equal size established parallel to the existing site

Consistent fuel quality

The heating value and the compositional characteristics of sludge depend on the nature of sludge as well as on the degree of digestion (or pretreatment) sludge has undergone. The minimum ash content for the sludge is 18.9 per cent, while the maximum value for the sludge is 58.68 per cent (the mean is 40.5 per cent). The higher ash content generally reflects sludge that has either been digested or heat-treated to convert a large portion of the organic constituents. To achieve the required heating value for RDF, sewage sludge and oily sludge are mixed in the proper ratio using the mean heating value of the oily and sewage sludge. These materials are mixed in the storage tanks/pits and then the mixed sludge is transferred to the hopper. From here the sludge is pumped by the mono pump to the kiln burner.

Safety guidelines are ensured as most modern multifuel burners have to meet specific requirements for controlling kiln temperatures. The alternative fuel is provided centrally through a tube to the burner nozzle. The particles come into rotation due to tangentially-aimed air jets – right before leaving the burner.

Quality control

Upon receiving the material on site, random samples are taken to check homogenisation of the material. The bulk in total to be analysed, the mode,

Table 1: sewage sludge contents

Metal	*Dry solids (%)*	*Moles metal/ kg dry solids*	*Soluble metal (mg/l)*
Copper	0.93	150	0.5
Cadmium	1.08	100	–
Zinc	0.97	150	1.0
Iron	9.56	1710	–
Chromium $^{6+}$	2.20	420	3.0
$^{3+}$	2.60	500	–
Nickel	–	–	2.0

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Clockwise from top left: manure packaging

Sludge filling for landfill site

Oil mix yard, Lafarge Emirates, UAE

Multifuel burner for alternative fuels

Sludge mixing plant at Lafarge Emirates, UAE

method of control, as well as the number of random samples depends on the kind of fuel.

Control systems include:

- visual testing – based on the operator's level of experience
- chemical analysis
- physical condition analysis.

Some samples are then given to the internal laboratory, while others are retained for processing. If the analysis shows all criteria will be fulfilled, the retained samples are sent to bulk storage.

Conclusion

The use of sewage sludge as alternative fuel is a common practice in cement plants around the world, particularly in Europe. It could also be an attractive business proposition for wastewater treatment plant operators and the cement industry in the Middle East, especially in the UAE. The advantages of waste sewage sludge could be promoted through government workshops or seminars which raise awareness of how the problems of sewage sludge disposal can be tackled sustainably whilst also reducing GHG emissions from the cement production process.

Sewage processing overview

Sewage can be treated close to where it is created. A decentralised system would include septic tanks, biofilters or aerobic treatment systems. Alternatively, sludge can be collected and transported by a network of pipes and pump stations to a municipal treatment plant – a centralised system. Sewage collection and treatment is typically subject to local, state and federal regulations and standards. Industrial sources of sewage often require specialised treatment processes.

Sewage treatment generally involves three stages of treatement:

- **Primary treatment consists of temporarily holding the sewage in a settling basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed, while the remaining liquid may be discharged or subjected to secondary treatment.**
- **Secondary treatment removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed habitat. Secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to discharge or tertiary treatment.**
- **Tertiary treatment is sometimes defined as anything more than primary and secondary treatment, which allows rejection into a highly-sensitive or fragile ecosystem (estuaries, low-flow rivers). Treated water is sometimes disinfected chemically or physically (for example, by lagoons and microfiltration) prior to discharge into a stream, river, bay, lagoon or wetland or it can be used for the irrigation of a golf course, greenway or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes.**



Tankers discharging at Jebel Ali



Sludge dryer building



Side view of dryer