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Tunisia: Waste management and the cement industry

The Tunisian government is currently examining the possibilities of reducing its cement industry's energy imports by using alternative fuels from waste. In the first in a series of articles on refuse-derived fuel (RDF) projects, Dirk Lechtenberg of MVW Lechtenberg discusses the prospects of RDF in the Tunisian cement industry.

Above and below-right: Landfills at Gabès, Tunisia. With around 10m inhabitants, Tunisia produces around 1.8Mt/year of household waste, corresponding to 0.8kg/day per inhabitant.

Tables 1 & 2, below: Tunisia's cement consumption and waste generation.

90% of the energy requirement in the Tunisian cement industry is covered by gas – which is largely imported – and imported coal and petcoke covers the balance. This creates a scenario which makes one think about alternative energy forms, e.g. fuels from waste.

The Tunisian government has for many years been striving to optimise the country's waste disposal structure, with great success. In 1993, the National Waste Management Program (PRONADGES) began. The Tunisian government is for this reason currently evaluating the possibilities of reducing energy imports by its cement industry using alternative fuels produced from waste (RDF), a common solution in Europe.

In 2007, the Tunisian cement industry produced about 7.3Mt of clinker, with cement consumption at 580kg per habitant or 6Mt in total. The GDP continually rises each year – most recently 5.8%, and causes the Tunisian cement industry to also think about capacity increases.

By the way of support from the World Bank, the International Reconstruction and Development Bank, the German KFW and others, seven new and modern waste collection centres and tips have been built. With around 10m inhabitants, Tunisia produces around 1.8Mt/year of household waste (municipal solid waste, MSW), corresponding to 0.8kg/day per inhabitant: a large 'energy potential' which is there to be used.

Tunisia: overview

Population:	10,195,000
Population growth rate:	0.99%
GDP real growth rate:	5.8%
GDP per capita:	US$8600
Cement consumption:	6Mt/year
Cement consumption per capita:	580kg
Cement Production:	7.3Mt/year

Tunisia: solid waste management

Background Information	• Population:	10.12m (2002)
	• Municipal Solid Waste (MSW) Generation:	1.8Mt (2002)
	• Per Capita MSW Generation:	0.8 kg/day (urban areas)
		0.2 kg/day (rural areas)
	• MSW Generation Growth:	2 % per year
Technical Performance	• MSW Collection Coverage:	90 % (rural areas)
		95 % (urban areas)
	• MSW Final Destination:	0.5 % composted
		5 % recycled
		50 % landfilled
		44.5 % open dumped

Cement industry as waste treatment companies?

MVW Lechtenberg, Germany, is currently investigating the possibility of secondary fuel usage from household waste in Tunisia. Apart from the technical and operational economic information, social economic factors (currency export for fuel procurement, costs for waste disposal, etc.) have to be evaluated. The potential for saving climate-harming gases (CO_2 as well as methane from landfills) is also calculated. The Minister of Industry (MI) as well as the State National Agency for Waste Management (ANGED) has already spoken directly with the Tunisian cement plants, to realise possible savings potential for fossil fuels.

Yet are experiences of the European cement plants with substitute rates of up to 80% RDF transferable to a country such as Tunisia? In many European cement plants, special, separated and suitable waste is processed into secondary fuels – in contrast to Tunisia, where an effective waste collection is now under implementation and where no separate collection occurs yet. In spite of higher objectives, only around 5% of the waste in Tunisia is sent for recycling – predominantly cardboard and paper, as well as metals

Fuel Consumption	Cal. Value (Kcal/kg)	Energy Subst. (units/ Y)		RDF Subst. (t p Y)	
		Precalciner	Main burner	Precalciner	Main burner
RDF	3500.0				
Coal	6000.0	0.0	0.0	0.0	0.0
Fuel Oil	9000.0	0.0	0.0	00	0.0
Petcoke	8000.0	0.0	0.0	0.0	0.0
Gas	8500.0	91,749,2	0.0	222,819,4	0.0
Bone Meal	3200.0	0.0	0.0	0.0	0.0
Tyres	8000.0	0.0	0.0	0.0	0.0
Sewage	2500.0	0.0	0.0	0.0	0.0
Total Consumption	**5,199,120,000**	**91,749,2**	**0.0**	**222,819,4**	**0.0**
Energy Losses due to RDF Subst.	**5.0%**			**234,546,8**	**0.0**
Total RDF Utilization (tpY)					**234,546,8**
Total RDF Utilization (tph)					**32.6**

Table 3, above: Calculation of energy substitution by RDF in the Tunisian cement industry (15% substitution rate over all cement plants).

Right: In 2007, Annual cement consumption in Tunisia stood at 580kg per habitant, or 6Mt in total.

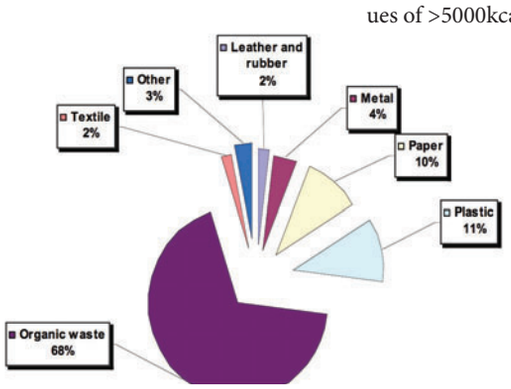
Below:

- Composition of municipal solid waste in Tunisia.
- Treatment of leachate water (the run-off from landfill), Djerbar.

and PET-bottles. Recycling of the materials is made possible due to market value. But what about RDF?

Studies carried out show that waste is tipped in a mixed form. At an organic content level of around 68%, consisting partly of very wet kitchen waste, food remains and other biomass, later separation of the 'high calorific-value' part from household waste is problematic. Only around 15-20 % of such waste can be used as a possible secondary fuel constituent. This corresponds to a volume of around 340,000t/year of RDF – in the whole of Tunisia! As a comparison: modern cement plants (precalciner) with 1Mt/year of clinker production in Europe use up to 150,000t of 'best quality' RDF.

The secondary fuel obtained from waste, in the context of waste characteristics, corresponds to only 3500kcal/kg compared to Germany, for example, where mainly only suitable secondary fuels with calorific values of >5000kcal/kg are used.



Effects on the process

The main problem when using secondary fuels is firstly the chloride and moisture content. The most important recirculation substances which can affect the operation of a cement kiln system are alkali sulphates and alkali chlorides. Secondary fuel made from MSW has a natural chlorine content of >0.4% resulting from natrium chlorides (cooking salt). As sodium chlorides in the raw materials (especially lime and clay) in Tunisia are already quite high, this may result in operational problems. Water, which is always in RDF up to 15%, reduces the available gas volume in the kiln. Additional energy is required to destroy the water content of RDF (energy losses).

In *Table 3*, a substitution rate of 15% for all Tunisian cement plants was calculated, corresponding to a volume of 230,000t/year.

Environment

The use of continuously-monitored secondary fuels in the cement industry has been long acknowledged as an environmentally-friendly method of waste recycling. High temperatures, a residue-free combustion as well as reduction of climate-harming greenhouse gases, especially CO_2 and methane gases from avoided waste-tipping, secure environmentally-friendly recycling.

For Tunisia, a theoretical savings volume of around 0.5Mt of CO_2 results – calculated based on a substitution rate of 15% in all plants. Not included in this calculation is the saved methane gas volume from avoided landfill disposal.

Economics

Production of secondary fuels is not free of charge, even if the raw material (waste) is, as a rule, available at no cost. The known production costs for RDF in Tunisia amount to around US$50–55/t and result from painstaking sorting/separating of the calorific-rich content, additional comminution, foreign-matter release (metals, stones, etc.), homogenising, storage, transport and feeding in the cement plant.

The investment for each cement plant – calculated based on a theoretical substitution rate of 15% – amount to around Euro1m only for the feed and conveying equipment. As natural gas is currently subsidised by the Tunisian government for the cement industry, secondary fuel use can not currently be economically carried out – no disposal fees are offered by the government for accepting the waste.

Conclusion

The cement industry can take on a significant role in Tunisia's sustainable development in regard to waste disposal. However, suitable framework conditions have to be created first of all by the government. Considerable waste volumes – even defined and suitable special waste, such as oil sludge, dried sewage sludge and other – can be recycled in an environmentally-friendly way in the cement industry.

Apart from immense savings potential for landfill capacity, climate-harming emissions are avoided and valuable energy resources are saved. Also, from a socio-economic point of view, the transformation of such an 'environmental' concept makes sense: Currency for raw material import is saved; new jobs are created in the collection, transport and processing of waste.

But all this costs money – and these costs can not be simply added to the cement industry's burden; also the waste producer – in this case the Tunisian cities – must play their part in the costs involved in such an environmentally-friendly concept to create a win-win situation.