Technology Fact Sheet for Mitigation
Sector: Industry
Sub-sector: Cement
Technology: Energy Efficiency and Saving in Cement Industry [i]

A.1 Introduction:
The utilization of Waste Materials including the Scrapped Tyres (calorific value 35.6 MJ /kg) have been used for more than 20-years worldwide as alternative (secondary) fuel in the cement kilns.

Cement kilns are well suited for waste-combustion because of their high process temperature and because the clinker product and limestone feedstock act as gas -cleaning agents.
Used tyres, wood, plastics, chemicals and other types of waste are co-combusted in cement kilns in large quantities.

Plants in Belgium, France, Germany, the Netherlands and Switzerland have reached average substitution rates of from 35% to more than 70%. Some individual plants have even achieved 100% substitution using appropriate waste materials. (Energy Efficiency & Saving in the Cement Plants at http://ClimateTechwiki.org website).

The utilization of scrapped tyres as alternative fuel in cement kiln is a proven safe and effective technology that has already been used in some cement plants in USA, Germany, Japan and Egypt.

The cement industry in the United States burns 53 million used tyres per year, which is 41% of all tyres that are burnt and is equivalent to 0.39 Mt or 15 PJ. About 50 million tyres, or 20% of the total, are still used as landfill (Energy Efficiency & Saving in the Cement Plants at http://ClimateTechwiki.org website).

So, the scrapped tyres as alternative fuel is one of the most recommended types of waste that can be used as a secondary fuel in cement kilns - besides the fossil fuel. Since it has a high calorific value (32 MJ/kg) compared to other wastes and even the Coal (28 MJ/kg).

Besides, it is the safest method of disposal due to its considerable reduction and control in the generated amount of pollution emissions and especially the toxic gases like dioxin, due to kiln high temperature (900 – 1450 degree centigrade) and short time taken for complete combustion.

So, one metric ton of scrapped tyres can produce in average 6.5 – 8.2 tonnes of cement, and its utilization can represent 20 – 50% from the total amount of fuel been burnt in a kiln. And accordingly, it will reduce our usage of fossil fuels (Heavy Oil) which automatically reduce the extra CO_2 emissions generated from fossil fuels – compared to the amount of CO_2 generated by scrapped tyres. Besides, a considerable reduction (more than 50%) in the energy (fuel) cost.

Cement manufacturing produces CO_2 as it requires very high temperatures to burn raw materials and give the clinker its unique properties.

$CO_2$is generated from three independent sources: de-carbonation of limestone in the kiln (about 525 kg CO_2 per tonne of clinker), combustion of fuel in the kiln (about 335 kg CO_2 per tonne of cement) and use of electricity (about 50 kg CO_2 per tonne of cement).

There are three central measures by which the cement industry may save direct CO_2 emissions in the immediate future:

Improvement of energy efficiency (a maximum of 2% is still feasible),
Reduction of clinker/cement ratio, and
Increase in the use of waste as alternative fuel (national initiatives, adequate national implementation of certain directives regarding specific waste)".

A.2 Technology characteristics

The scrapped tyre can be used as a whole piece or in shredded forms – including or excluding (after the removal of) the steel wires. The usage of shredded scrapped tyres without the steel wires is most preferable option.

Firstly, the scrapped tyre should be properly classified and verified. Secondly, they need to be shredded into 25 – 50 mm chips, and then the steel wires will be removed. The third step is to feed the chips through the feeding belt and dosing system into calciner and/or kiln for combustion.

The high temperatures of the Kiln (1400 – 110 degree centigrade) and the calciner (1000 – 900 degree centigrade) will secure complete combustion free of toxic emissions like the generation of dioxin gases.

The combustion parameters & conditions need to be monitored and controlled effectively and carefully to secure complete combustion of tyres chips and to maintain the emissions within the acceptable limits.

Table (1): Estimated Cement Production per tonne of Fuel used

Fuel Type	Approximate CV"(MJ/kg)	Cement (Tonne)
Furnace Oil	40	**11**
Coal	28	**7.2**
Tyres	**32**	**8.2**

A.3 Country specific / applicability

Last year the Global demand for cement grew by 17% by the end of year 2011 to reach 3.8 billion metric tonnes – as per worldcement.com.

In Sudan, as per Ministry of Industry Records, the demand for cement and the design capacity of the cement plants during the previous three years – from beginning of year 2009 to end of year 2011, have been increased by almost 500%, reaching 3 million tonnes as consumption by end of year 2011, and 6.97 millions of metric tonnes as a total design capacity.

In Sudan the annual imported amount of tyres for different applications is estimated last year by 20,000 tonnes, and expected to reach 40,000 tonnes by end of year 2012.
Generally the new tyres lose about 20% of its weight before it has been scrapped. The steel wires represent about 15 – 25% of the tyre weight which encourage some people to burn the tyres in open areas to get use of the steel wires which has a considerable value.

A.4 Status of technology in country
This technology is of shredding & burning tyres is not introduced in Sudan yet.

A.5 Barriers
• Inaccurate dissemination of information; increases the worries of public and governmental authorities about managing (controlling & monitoring) pollution emissions; especially the toxic emissions like dioxin gas.

• The scrapped tyres are spread into wide areas all around the country, so it will be a difficult job to collect, classify and storing them properly, considering all the necessary precautions especially fire.

• The feasibility study will cost about 50,000 Euro, while the tendering, selection and purchase of equipment like shredding system, fuel handling and dosing system and the minor modifications need to be made in the cement kiln will cost about 1.6 million Euro in addition to 1.6 million Euro for civil work, erection, installation, commissioning, project management fees, consultancy fees and site preparations, etc.

• The duration for the execution of the project including the preparations of the pre-feasibility, comprehensive feasibility study will take about one year, including 7 months for supply and manufacturing of equipment.

A.6 Benefits to economic / social and environmental development
• The plan is to shred 25,000 tonnes/ year of scrapped tyres during the first four years of production to produce 5,000 tonnes/year of steel wires which cost more than 650,000 Euro per year. Moreover it produces about 150,000 tonnes of cement which will save about 15,000,000 SDG per year.

• The high revenue of the project will encourage the usage of other waste besides the scrapped tyres. The collected house hold waste in Khartoum state only is above 2,000 tonnes/ day, considering that the five big cement kilns located at 320 km north Khartoum can burn the majority of waste types and all the quantities available in Sudan.

A.7 Costs
A. Shredding System
• Equipment Cost = 1,000,000 Euro
• Other Costs = 1,000,000

B. Fuel handling & dosing System
• Equipment Cost = 600,000 Euro
• Other Costs = 600,000 Euro

C. Operational Cost

• Cost for 25,000 tonnes of scrapped tyres = 12,500,000 SDG (500SDG per tonne)
Other Costs = 7,500,000 SDG (General Estimation)

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment for Climate Change Mitigation - Sudan. You can access the complete report from the TNA project website http://tech-action.org/**