Alternative Fuels in India

The cement Industry in India is marred by the increasing fuel costs. As Alternative Fuels are one possibility to reduce clinker production costs, Dirk Lechtenberg talks on how to use alternate fules efficently.

The cement Industry is suffering from addition of new capacities which will result in under-utilisation of new as well as existing capacities. The cement Industry today is characterized through:

a) addition of new capacities which will weaken the pricing power of manufacturers
b) Government's negative attitude towards the industry (CO_2 Issue)
c) Increase in operating costs resulting in lower margins
d) Slowdown in real estate and construction activities resulting in lower demand growth
e) Higher financing costs resulting from financial crises. Due to lower demand of clinker, the current situation requires the following conclusion:

Not the Capacity is important: The lowest Production cost per tonne of clinker is now important! But how to reduce the production costs?

The first classical cost- cutting exercises are already implemented or in due course in the cement industry, such as laid off employees, cutting of wages, investment stops and others.

Due to the excellent market situation of the cement Industry in the past years, most companies have focused on an increase in production and market shares with takeover of competitors and building up more capacities. Most of the market participants were growing without any optimization of the organization or production.

The multinational groups like Holcim, Heidelberg Cement and Lafarge have a long term experience with the use of Alternative Fuels and Raw materials (AFR) and have built up their internal organisation focusing on AFR. The following table shows the cost reduction volume with a substitution of 25 per cent rice husks at market conditions in September 2012.

Kiln Production

Daily Production	Production Rate	Clinker Production
[tpd]	[tph]	[tpy]
3,300	138	1,023,000

Fuel Consumption

Calorific Cons.		[%]	[tph]	[tpy]	[KCal/kg Coal]	[KCal/kg Rice Husks]
[KCal/kg Clk]	Total	100	19	144,925	6,000	3,500
850	Precalciner	59	11	85,506		
	Kiln	41	8	59,419		

Kiln Operation

[hrs]	[days]	[hpd]
7,440	310	24
Revenue per ton cement [$ / t]		
Coal Cost [$ / t]	145	
Rice Husk Cost [$ / t]	30.00	

SUBSTITUTION of Rice Husks September 2012

Kiln is in operation with nominal capacity

	Rice Husk Substitution							
	Calorific Value	Calorific Value				RDF Cost	Equivalent to Coal	
	Burner [%]	Total line [%]	t/h	t/day	t/year	[$ / y]	tpy	[$]
Substitutionrate Precalciner in %	36%	21.2%	7.1	170	52,769	1,583,078	30,782	4,463,400
Substitutionrate Main Burner in %	10%	4.1%	1.4	33	10,186	305,585	5,942	861,579
Substitutionrate all Burner in %		25.3%	8.5	203	62,955	1,888,663	36,724	5,324,979
							Savings from Substitution RDF	3,436,317

Above shown Calculation is for a "standard" 1 mio tons Clinker production Plant with Precalciner, calculated without thermal losses and with a Rice Husk purchase price of 30 UD$ at the flame. Values for CO^2 emission reduction are not calculated

Even with lower fossil fuel prices, the use of Alternative Fuels can have a significant cost reduction. In India, many municipalities or regions usually don't have established collection and disposal infrastructure for wastes, such as agricultural wastes or municipal solid wastes. Therefore a collection and eventually processing have to be developed by the cement plants or contractors. Collection and use of biomass wastes, such as rice husks or coconut shells is easier to implement, as no processing is needed and the available trucks for Cement transports can be used.

Table 3: Calorific Value of Biomass Wastes

The use of alternative Fuels is well known in the Cement industry, but even due to the current market situation, this is not the score business of a cement plant and often failed by the following constrains:

- Not the score business and
- No experience of Employees
- Permitting problems
- No human resources for development
- Cut and dried opinions
- Advanced arguments (in Europe they get clean wastes, but not here!)
- Communication failure with communities
- Wrong economical figures and assumptions (cement plants are thinking that high investment costs are needed for storage, dosing and feeding systems according to "German Standards")

MVW Lechtenberg has developed a 3-stage plan, which allows the cement plants to be on the safe side while starting up the use of RDF. For turnkey project implementation, the company works on the following three phases:

Phase I

Verification and classification of existing wastes types available at source,

- Suitability of available wastes as AF, and recommended feeding points.
- Quality requirements of alternative fuels,
- Impact of AF utilization on clinker chemistry and production process,
- Impact on air quality (emissions),
- Thermal energy substitution, and economical benefits,
- Possible Greenhouse Gas emission savings (CO_2 Calculation) and legal requirements.
- Project capital investment cost evaluation and return on investment.

In this stage, the communication with the society and with the Authorities is most important. Especially in India are many constraints of the Authorities against the use of Alternative Fuels, as this is considered as "waste incineration". Often, e.g. in the emirates, are many local arguments against the foreign multinational cement groups in the use of alternative fuels. ("There are coming here, using cheap labor, paying no taxes and polluting the environment") Therefore, the communication, explanation and lobbying pro Alternative Fuels are one important activity of MVW Lechtenberg. In this article we focus only on the development of Phase I, but will give a short overview about the following working stages:

Phase II

- MVW will support the cement plant in equipment choice, requisition and equipment verification.
- Support in negotiation contracts with waste suppliers
- Permitting issues
- Development of "Turnkey-Project" incl. engineering and sketch drawings for imported and local manufactured items.

Pic.1: Public presentation for the Use of Alternative Fuels by MVW Lechtenberg at Authorities and NGO`s (Friends of the Earth) in the Philippines.

Phase III

- support in the successful implementation of the Alternative Fuels project incl. ongoing monitoring / quality management

The use of alternative Fuels and the development of such a project is always standardised, despite local or technical differences. Each Kiln responds different on the substitution of Alternative Fuels, and in the vicinity of cement plants are always different

Pic.2: Coconut shells, Tyres, Wood chips and Rice Husks as alternative Fuel in a cement Plant

types of wastes available.

Most of the cement plants use Alternative Fuels "by chance".

The basic principles for the use of

Alternative Fuels are as follows:

- The chemical quality of the fuel must meet regulatory standards, assuring environmental protection.
- The calorific value of the fuel must be stable enough to allow control of the supply of energy to the kiln, as the achievement of homogeneous clinker requires a well controlled combustion process.
- The physical form of the fuel must allow easy handling of the material for transportation and a controlled flow into the kiln.
- The fuels must not introduce the chemical species into the clinker production process that might be deleterious to the stability of the process or the performance of the product.

The Quality of agriculture wastes such as rice husks, coconut shells or Bagasse is, depending on the origin, with a high variation of moisture content, silicate or other constituents. Therefore detailed analyses are needed.

Waste Type	Rice Husk
H2O [%]	10.0
ASH [%]	>25
Ct [%]	39.0
Ht [%]	2,97
St [%]	0.07
N [%]	0.49
O2 [%]	36.36
Cl [%]	0,2
Net heating value [kcal/kg]	3371.3
Volatile matter [%]	61.4
SiO2 [%]	89.12
AL2O3 [%]	3.08
FE2O3 [%]	0.80
CAO [%]	2.50
MGO [%]	0.74

Table: Typical Analyze of Rice Husks

Based on these analyses, detailed study about the effects on Cofiring these fuels have to be done. MVW Lechtenberg has developed a tool to calculate these effects on a theoretical base, which will give the cement plant a detailed summary on such effects and guidelines and recommendations for the substitution.

Carbon Credits

The Kyoto Protocol to the United Nations Framework Convention on Climate Change strengthens the international response to climate change. The developed countries commit themselves to reducing their collective emissions of six key greenhouse gases by at least 5 per cent..

Under the Kyoto Protocol, the EU committed itself to reducing its greenhouse gases emissions by 8% during the first commitment period from 2008 to 2012. This target is shared between the Member States under a legally binding burden-sharing agreement, which sets individual emissions targets for each Member State. Under the EU emissions trading scheme, which is mandatory, the EU Member States will cap direct CO_2 emissions from energy-intensive companies (steel, power plants, oil refineries, paper mills, glass and cement installations) by issuing allowances as to how much CO_2 these companies are allowed to emit. Reductions below the limits will be tradable. Companies that achieve reductions can sell them to companies that have problems staying within their limits or for which emission reduction measures are too expensive in comparison with what the allowances will cost. Any company may also increase its emissions above the level of allowances it is issued by acquiring additional allowances from the market The Commission adopted on 23rd July 2003 a proposal that links credits from JI and CDM projects with the emissions trading system. Indeed, under the Kyoto Protocol, Joint Implementation (JI) and the Clean Development Mechanism (CDM) will allow industrialised countries to achieve part of their emission reduction commitments by conducting emission-reducing projects abroad and counting the reductions achieved toward their own commitments. Under this proposal, companies and Governments will be allowed to convert credits from JI and CDM projects for use towards meeting their commitments. JI and CDM allow respectively for the creation, acquisition and transfer of "emission reduction units" (ERUs) and "certified emissions reductions" (CERs). Projects of Cement Plants which are intending to use Alternative Fuels such as Biomass or Refuse Derived Fuels with a certain biogenic (renewable) content, can get "Certified emission reductions" CER`s in order to finance their Alternative Fuel Projects, as the fossil CO_2 emissions are reduced.

There are two sources for "Green House gas "emission savings:

- Reduction of Landfill gas (Methane) if RDF from Municipal Solid wastes is used and fossil fuel emission in the Kiln.

MVW Lechtenberg is calculating the possible CO_2 emission savings and developing the needed procedures to receive such CER`s.

Storage / Dosing / Feeding systems

There is a huge variety of needed technical Equipments for Storage, Dosing and feeding of Alternative Fuels available on the Market. As there is no "standard" utilisation, it is advised to start with simple technical equipment in order to be able to gather some experience before investing in a "state of the art" technology. Especially in these days, lowering the investment costs is one mayor key in a successful alternative fuel implementation. As an example, the investment costs for a "state of the art" storage, dosing and feeding system for 10 tons Rice Husks is available on the market for 5 mio €, but can also be implemented for less then 500.000 €.

Such a system is consisting of a receiving area, feeding a hopper with a wheelloader, volumetric or gravimetric dosing, and pneumatic transport system. In India, MVW Lechten-

berg is collaborating with TECPRO SYSTEMS- which is a leading EPC contractor for such systems. In Ajmer, Rajasthan, the first RDF Production facility was built by Tecpro Systems and MVW Lechtenberg; processing 300 tons of mixed Municipal Solid wastes into defined refuse derived fuels.

Most important for such Investments is the flexibility of the system. This flexibility is needed to be independent in the purchase of various alternative fuels. One example: if the rice farmers asking to high prices for the rice Husks, the cement Plant can switch to olive kernel or other available Fuels. This is also important in order to use Refuse derived Fuels (RDF) , consisting of paper / plastics fractions with the same installation.

The use of RDF made from industrial wastes or Municipal Solid Wastes (MSW) is common practice in European and some Asian cement plants, as an existing waste collection and disposal infrastructure exists.

Economics on clinker production process

The total production costs for RDF are, depending on the local energy and labor costs are calculated with 25- 30€ / tonne. Therefore in India the use of alternative fuels made from industrial wastes or Municipal Solid waste is highly economic with the current high fossil fuel costs. MVW Lechtenberg has developed a calculation tool to implement different waste types, separation values, transport distances, gate fees (or input costs) and production costs on local base. Wear and spare part costs, based on working experience with different waste materials and different equipment suppliers are integrated in the modular system. Typical Production costs (maintenance, energy, wear parts/ spare parts) for RDF from mixed industrial wastes are starting at 15 € / ton plus Labor and Depreciation costs. It is foreseen, that the fossil fuel prices will increase further- with a higher need to implement alternative fuels and cost reduction by e.g. waste heat recovery.

MVW Lechtenberg has developed a "low cost startup package" for cement Plants which are intending to use Alternative Fuels made from Municipal Solid wastes and other available biomass wastes. This start up package consists of Equipment's from well-known Indian and European equipment suppliers for the production, dosing and feeding of such fuels to the Kiln and includes the needed Feasybility studies, Environmental Impact assessment and training for the start up period. This start up package with a feeding capacity of 10 tonne RDF/Alternative Fuel is available for a lump sum of 3,5 Mio €. Interested parties can visit such Installation, developed by MVW Lechtenberg and TECPRO SYSTEMS in Ajmer, India.

The use of RDF has a direct impact on the clinker production process and production capacity. The presence of chlorine is the most critical factor in the thermal process. Chlorine may react with calcium. In that case it will end as $CaCl_2$ in the clinker. But most of it will react with sodium or potassium to NaCl or KCl. These salts sublimate in the calcinations zone and recristallise in the decarbonisation zone, which results in an internal chloride cycle. As the chloride concentration increases this may lead to blockages in the cyclone pipes, resulting in a kiln shutdown. To fore come this, the chlorine content of the substitute fuel must be monitored carefully. If there is higher chlorine content in the substitute fuel, input of that fuel must be reduced or a special bypass must be constructed to clean the gases from NaCl and KCl.

Pic. 5 Screening of Municipal solid wastes

At the same time presence of Alkalis as also Sulphur has to be monitored carefully. Any unbalance in the system will provide to ring formations in the kiln and build ups at kiln inlet and lower stages cyclone preheater.

Introduced Humidity of the fuels will reduce the available gas volume. More Oxygen will be needed for the complete incineration of bigger sized RDF will be needed. (Increasing the Fan Capacities with higher energy consumption). As a Result, the efficiency losses (thermal efficiency) will be at least 10% of the introduced RDF. (From 1000 kcal introduced RDF, only 900 kcal will be used for heating purposes, 10 per cent are lost due to the composition and extra needed energy input).If a clinker production loss will occur is depending on the following circumstances:

- Humidity / quality of RDF
- Quantities of introduced RDF
- Kiln performance

From our experience we knew, that a substitution of up to 20 per cent substitution rate (in calorific value) can be done without any clinker production losses. With certain modifications, higher substitution rates can be achieved. If we look at the German cement Industry with an average alternative Fuel substitution of almost 61% in 2012 with solid alternative fuels, the production rates are only 90- 95% of the designed kiln capacity. With such high substitution rates of alternative fuels, the clinker production costs can be reduced by up to 10 € per ton of clinker! With possible "gate fees" for hazardous wastes, these figures can be optimised. Especially in India is normally no existing disposal of hazardous wastes such as solvents, oils, refinery sludge, pesticides and others available. **The cement plants can take a significant role in the environmental friendly disposal and use of such wastes especially in developing countries.**