MVW
LECHTENBERG & PARTNER

lechtenberg & partner

Publication of
MVW Lechtenberg & Partner
Germany

03/2019

Co-Processing Magazine of Alternative Fuels & Raw Materials

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Dear Readers,

The last two months have been eventful for both us as a company and the worldwide industry.

We are very happy to have had the opportunity to welcome representatives from the global alternative fuels community to our 6th Alternative Fuels Symposium in Duisburg, from 23 to 25 September. Each year, we are proud to host the event and thereby provide a fruitful platform for a sustainable future. We hope all participants had a pleasant, informative and successful experience and look forward to welcoming you again next year. On the following pages, you will find a short recap of the 6th Alternative Fuels Symposium.

Also included in this edition of the Co-Processing Magazine, we gladly present the 1st Alternative Fuel Award winning project: Arabian Cement Company, Egypt, and their "Alternative Fuel Case Study". Starting on page 5, the project description will provide you with a great example of how waste-derived fuels can be used even in developing countries without a structured waste management system.

Parallel to the symposium, the UN held its 2019 Climate Action Summit in New York. UN Secretary General António Guterres emphasized the urgency of the Summit: "I want to hear about how we are going to stop the increase in emissions by 2020, and dramatically reduce emissions to reach net-zero emissions by mid-century". At the same time, the sustainable development goals should not create winners and losers or add to economic inequality; "they must be fair and create new opportunities and protections for those negatively impacted, in the context of a just transition" [1].

As an indicator of the growth and progress of a country or region, and with an expanding world population and increasing demand for cement, the cement industry is expected to continue to grow in the coming years. Thus, the industry faces a great challenge for the near future: maintaining growth while reducing emissions and environmental impact.

Nevertheless, climate solutions can have several benefits, such as strengthening economies and creating jobs, while bringing cleaner air, preserving natural habitats and biodiversity, and protecting our environment.

One example of how using plastic wastes as alternative fuels entails multilayered benefits is described in the article "Our Plastic Oceans" on page 19.

Even though substituting fossil fuels with alternative fuels can help reduce fossil emissions, it is not a clima neutral option. Thus, when using alternative fuels, environmental regulations and emission limits need to be considered. In an exclusive excerpt from the Alternative Fuels and Raw Materials Handbook starting on page 9, you can learn more on emissions monitoring, permitting issues and how to apply for permissions.

Enjoy reading this year's third edition of the Co-Processing Magazine!

Yours sincerely,

Dirk Lechtenberg

References:

[1] https://www.un.org/en/climatechange/un-climate-summit-2019.shtml

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

6th Alternative Fuels Symposium – Recap

6th Alternative Fuels Symposium - Recap 23 – 25 September 2019, Duisburg

By Marie Lechtenberg

Three weeks have passed since we have had the opportunity to welcome almost 140 members of the alternative fuel's community from 36 different countries at our 6th Alternative Fuels Symposium. We would like to thank all participants and speakers for their engagement and enthusiasm which made it possible for us to organise such a variety of lectures and provide everyone with high-quality insights into the "alternative fuel markets" in different countries and industries. Everyone who could not attend will read a short summary of the symposium in this article, and for everyone who did – enjoy the recap!

Monday, 23 September 2019 – Field Trip

This year's Field Trip took place at HeidelbergCement plant Ennigerloh. The plant replaces more than 75% of fossil fuels with alternative fuels such as RDF, tyres and liquid fuels in compliance with the highest emission protection regulations and is one of the most efficient German cement plants. Registration started at 11:30 a.m. at Wyndham Duisburger Hof Hotel, and the bus left for Ennigerloh at 12:30 p.m. During the bus ride, the participants learned more about the area of Ruhrgebiet and the cement plant's history. The tour at the plant was divided into groups and guided by Heinz Bröker from HeidelbergCement and Dirk Lechtenberg from MVW Lechtenberg. After the trip, the participants had the opportunity to join a get together at restaurant Belvedere in Duisburg Ruhrort to wind up the day with a networking dinner and drinks.

Tuesday, 24 September 2019 – Day 1

The first day of the 6th Alternative Fuels Symposium started at 8 a.m. with registration and coffee. All participants received their conference bag, including small gifts, the programme and all presentations on a USB stick. After a short welcoming introduction by Dirk Lechtenberg, Dr. Estelle Herlyn gave an overview of sustainable development and CO_2 reduction potential worldwide to provide a framework for the symposium. Further topics on the first day of presentations included best practices in cement emission reduction, innovations in RDF production and production equipment, and fire protection in RDF plants. At the end of the first day of presentations, the participants were invited to join a relaxing boat tour with a festive dinner. The MS RheinPoesie took all guests on a cruise on the Rhein river, passing Duisburg city with changing scenery from a bustling city, busy harbour to peaceful oasis with green meadows. During the joint dinner aboard the ship, the winners of this year's alternative fuels competition have been honoured (for names and projects see speakerslist below). The winning projects have been shortly presented and Dirk Lechtenberg handed on the Alternative Fuels Awards to the representatives of these companies.

Wednesday, 25 September 2019 – Day 2

The second day of presentations started with a welcoming coffee at 8:30 a.m., to slowly settle in after an eventful evening the day before. This year's Alternative Fuel Award winners have been presenting their projects among other selected speakers, which you will find in the speakers' list. The presentations on the second day mainly focussed on country reports and case studies, to provide the participants with specific insights into different alternative fuel markets. The day ended with a networking lunch and the annual lottery which determines the winner of the Alternative Fuels and Raw Materials Handbook vol. 1 & 2. Once again, congratulations to the winner!

Since the lottery is drawn from the entries for the symposium questionnaire, we would also like to share some of the insights gained from our survey:

At this year's symposium, the presentations by Florian Salzer (4.58 out of 5 points) and Dr. Estelle Herlyn (4.5 out of 5 points) have achieved the highest ratings from the participants. Congratulations! We thank them and all other speakers who have all achieved great ratings throughout for their highly informative presentations.

This year has also brought some new digital features to the symposium. Our web app and the online questionnaire were intended to facilitate the information flow about and during the programme, and to reduce the amount of paper such an event requires. As every technological trial, it might have entailed some start-up difficulties, and not all participants have used the app and questionnaire. Nevertheless, the feedback showed us that most participants prefer the information and marketing material as soft copy on a USB stick and/or as in-app downloads compared to the conference bag.

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Thursday, 26 September 2019 – Workshop

This year, we offered an optional Alternative Fuels Workshop dedicated to alternative fuels users from the cement and lime industry, due to many requests in previous years. The workshop gave those interested the opportunity for an in-depth lecture on the use and impacts of alternative fuels in a small and interactive environment with room for open discussion. It included a series of lectures provided by Dirk Lechtenberg, Dr. Hansjörg Diller and Vladimir Dimitrov, who guided the participants through the process of alternative fuels implementation, including technical requirements, procedure, and evaluation.

The workshop was held based on a specifically created coursebook which has been given to all participants. The day ended at 5 p.m after each participant received a certificate for completion of the workshop.

The end of the workshop also marked the end of an informative, pleasant, and very successful 6th Alternative Fuels Symposium. But, as every year, after the symposium is before the next symposium for the MVW Lechtenberg team, and we will soon be able to announce the dates of the upcoming 7th Alternative Fuels Symposium. Until then, stay up-to-date with our newsletter, and we look forward to welcoming you again next year!

On the right: *Symposium speakers Florian Salzer from w&p Zement GmbH and Dr. Luigi Di Matteo from Di Matteo Förderanlagen GmbH.*

6th Alternative Fuels Symposium – Recap

The speakers of the 6th Alternative Fuels Symposium were:

- **Mir Kazim Ali**, Vice President Cement Quality at PSCL, Canada: “Waste Fuels Information Management System (WFIMS) for Geocycle” – 3rd AFA Winner
- **Dimitrios Bakoulis**, CEO at Antipollution S.A., Greece: “Alternative Fuels Market in Greece”.
- **Dr. Arif Bashir**, General Manager at DG Khan Cement, Pakistan: “Overview of the Cement Industry in Pakistan & DG Khan’s RDF Activities”.
- **Philipp Biedenkopf**, Senior Area Manager at Amandus Kahl GmbH & Co. KG, Germany: “Processing of Waste Fractions to Alternative Fuels”.
- **Konstantin Bojinov**, Head of Geocycle Russia, Russia: “RDF Market in Russia”.
- **Dr. Luigi Di Matteo**, CEO of DI MATTEO Förderanlagen GmbH & Co.KG, Germany: “Closing the Loop – Best Practices in Efficient Alternative Fuels Utilization”.
- **Fritz Driessler**, Sales Manager at Lindner-Recyclingtech GmbH, Germany: “YES, WE CAN?! Premium RDF production in the US”.
- **Jan Gressmann**, Product Manager CONVAERO at Eggersmann Anlagenbau GmbH, Germany: “The Cilacap Experience; RDF Quality Produced from MSW in a Developing Country”.
- **Prof. Dr. Estelle Herlyn**, Head of the Competence Centre for sustainable development at FOM University of Applied Science in Düsseldorf: “Globalization, Development, Climate – Navigation Through Stormy Water”.
- **Kalle Kivelä**, Sales Director at Cross Wrap Oy Ltd., Finland: “Cross Wrap Solutions in Alternative Fuel Handling”.
- **Georgios Koufodimos**, Mechanical Engineer at Herhof GmbH, Germany: “Power Plant Post-Combustion Carbon Dioxide Capture”.
- **Rafael Fenerich Mauri**, Co-processing Manager at Intercement S.A., South Africa: “Co-processing at Simuma Plant”. – 2nd AFA Winner
- **Arian Middleton**, Supply Chain Engineer at EEW Energy from Waste GmbH, Germany: “Waste Incineration in the European Context Between Risks and Opportunities”.
- **Andreas Nitzsche**, Sales Manager at Anlagenbau Günther GmbH, Germany: “SPLITTER® – for RDF production”.
- **Mark Müller**, Marketing Manager at Orglmeister Infrarotsysteme, Germany: „Fire Detection and Protection in Waste Processing Facilities and RDF Storages”.
- **Kazem Moshir**, Shift Leader at Arabian Cement Company, Egypt: “Alternative Fuels in ACC”. – Ist AFA Winner
- **Florian Salzer**, Plant Manager at Wietersdorfer & Peggauer Zement GmbH, Austria: “State-of-the-Art Technology in Emission Reduction – Experience Report from Wietersdorfer Cement Plant”.
- **Ram Badanmani Tripathi**, Unit Head at JK Cement Works, India: “AFR Journey up to 10% TSR Without Affecting the Quality and Production of Clinker”.
- **Leoš Voleský**, Head of Sales at Schenk Process s.r.o., Czech Republic: “Increasing Efficiency and Flexibility for the Alternative Fuels Co-processing”.
- **Hans-Joachim Walther**, Waste Stream Management at Schwenk Zement KG, Germany: “Co-incineration of Sewage-Sludge in a Cement Plant”.

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Co-Processing Magazine of Alternative Fuels & Raw Materials

1st Alternative Fuel Award Winner 2019: Arabian Cement Company

After a successful inauguration in 2018, MVW Lechtenberg has presented the 'Alternative Fuel Award' for the second time during this year's 6th Alternative Fuels Symposium. Companies, cities, municipalities, institutions, and individuals who have implemented or are currently implementing projects for the production, use or research on alternative fuels (from waste or biomass) were asked to submit their projects. The aim of this competition is to promote the acceptance of sustainable production and use of alternative fuels in the cement industry, and to identify projects that are considered by the industry to be a successful reduction of fossil fuels service.

This year, the first prize combined with €5,000 as well as travel costs and participation in the Alternative Fuel Symposium has been given to a cement plant located in North Africa.

The following description is an excerpt of the application by the Arabian Cement Company (ACC), Egypt, for this year's Alternative Fuel Award. It is a great example of how waste-derived fuels can be used even in developing countries without a structured waste management system.

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

Picture 1: *HOTDISC installation at ACC. Source: ACC.*

Background

ACC was established with the aim of building a cement plant with a capacity of 2.5 million tonnes per year, producing grey cement for the local Egyptian market. However, due to market conditions, the project was halted for a while until September 2004. ACC was able to resume its activities when the Spanish cement group Cementos La Union decided to invest in the company.

Now, ACC has a production capacity of 5 million tonnes per year, producing high-quality cement for the local and international markets.

In 2014, the Egyptian government has started a strategy for phasing out energy subsidies. This has driven ACC to put additional efforts in improving their energy performance. ACC decided to implement an EnMS complying with ISO 50001. The company was able to establish an EnMS that institutionalized a systematic approach in managing, monitoring and improving energy performance and increasing alternative fuel total substitution rate. These efforts were crowned by the certification through third-party auditing by TÜV Rheinland from Germany.

ACC adopted and applied integrated management systems combining ISO 9001:2015, BS OHSAS 18001:2007, ISO 14001:2015 and ISO 50001:2011.

The company has been continuously thriving to improve its energy and environmental performance supported by a strong management commitment. In 2015, the company participated in an energy benchmarking study for the Egyptian cement sector where ACC was evaluated as the top performer within the sampled organizations. This has further motivated the management to continue pouring its efforts towards a more sustainable production.

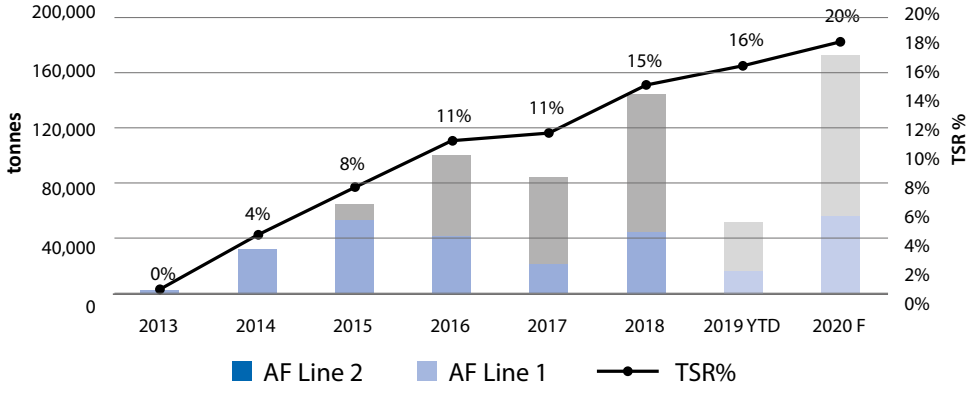

Figure 1: *Thermal substitution rate at ACC. Source: ACC.*

Alternative Fuels in ACC

In 2012, ACC launched an ambitious plan for complete conversion from natural gas, as a primary fuel, to solid fuels, mainly coal and alternative fuels and raw materials (AFR). This secured the steady operation of the plant following the country's energy crisis in 2011, which led to supply shortages of natural gas.

By the end of 2012, ACC started the construction of the first alternative fuels system which was commissioned in November 2013. The system comprises of a shredding, a storing and a dosing facility to feed shredded AFR to the pre-calciner of line 2. The system has a designed capacity of 12 t/h which can achieve up to 12% thermal substitution rate (TSR) of that line. This is equivalent to 6% TSR of total plant fuel.

In 2013, ACC signed a new contract for engineering and supply of the second alternative fuels system for line 1 (HOTDISC). The construction works started in 2014 and the system was commissioned in May 2015.

The HOTDISC

The HOTDISC installed in ACC is the first of its kind in Egypt, Middle East, and Africa, and was considered to be the biggest installed HOTDISC ever by the time of construction. It has a designed capacity of 30 t/h and can achieve a TSR of up to 40%.

The main advantage of the HOTDISC installation compared to other alternative fuel installations is the flexibility to burn a wider range of solid fuels with different sizes and various specifications. This is enabled by the variable speed of the rotating disc. It provides flexibility to adjust the residence time of alternative fuels on the disc from a few minutes to up to 45 minutes which ensures higher combustion efficiency compared to conventional calciner firing.

The HOTDISC installation consists of two intake points for bulk solid fuels and pulverized solid fuels, dosing equipment for each type, a system of conveyors to the feeding point and the HOTDISC reactor which is attached to the pre-calciner of line 1. Since it was commissioned in mid-2015, the HOTDISC has burned close to 232,000 tonnes of AFR that helped to increase the plant's TSR from 4% in 2013 to 16% in 2019 (see figure 1). This marks one step forward in ACC's plan to reach an overall TSR of 20% by the end of 2020.

Types of Alternative Fuels

Next to the price per heat unit of alternative fuels compared to traditional fuels, many other

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

factors play an important role when it comes to sourcing alternative fuels for cement plants. One of the main factors is the fuels' quality. To define the quality of AFR, several factors need to be taken into consideration:

1) the physical properties such as dimensions, humidity or presence of foreign materials that determine whether it can be safely stored and handled on-site or not, 2) the chemical properties such as net heat value (NHV), chlorine and ash content that can impact the kiln system and clinker quality, and 3) most importantly, the uniformity of quality consistency over time.

Another important factor when sourcing alternative fuels for cement plants is the availability of materials throughout the year.

ACC has four main types of alternative fuels that are used regularly and represent more than 95% of the AF fuel mix. Figure 2 shows the alternative fuels mix at ACC.

The main type is refused derived fuel (RDF), as it represents almost 54% of ACC's alternative fuel mix. RDF is considered one of the final products from the municipal solid waste treatment plants. It comes as bulk or pre-shredded and is characterized by its relatively good prices and availability throughout the year. However, its main disadvantage is the fluctuation in quality which is due to, for example, different treatment technologies or different site locations (near or far from major cities). This makes it more difficult to process without affecting clinker production or quality.

The second main alternative fuel is biomass. It represents almost 36% of the alternative fuel mix at ACC. Biomass includes mostly agricultural wastes such as tree trimmings or rice husks. It also comes as bulk or pre-shredded. Its main advantage is the stability in quality compared to other types of solid fuels. However, a disadvantage of biomass is unavailability throughout the year as it is only available during certain seasons depending on its source.

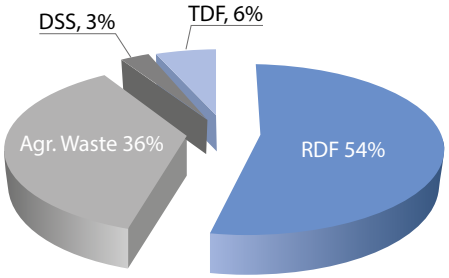

Figure 2: *Alternative fuel mix at ACC. Source: ACC.*

The third type of alternative fuel is tyre derived fuel (TDF) which can come as whole tyres or pre-shredded. ACC only uses shredded tyres since the conveying system is not designed for whole tyres. TDF is considered one of the best fuels due to a very high NHV and consistent quality which makes it the most economic fuel and the most convenient for kiln operation. However, the available quantities are very limited. It therefore has to be used in combination with other alternative fuels.

Finally, the last type of alternative fuels which is used regularly but with lower quantities is dried sewage sludge (DSS). DSS comes as fine

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

material and has to be handled in a separate conveying and dosing system than RDF or other types of fuel. It is supplied by sewage treatment plants and is characterized by a very stable quality but also by generally low quantities.

There are many other types of fuels such as shredded plastics, industrial wastes and more that can be used as alternative fuel in cement kilns, but these are not available at sufficient quantities to cover the kilns requirements. They represent less than 5% of the AF mix at ACC.

Challenges of Alternative Fuel Usage on HOTDISC:

Kiln specific heat consumption:

RDF is the major alternative fuel on HOTDISC. However, as mentioned before, its main disadvantage is quality fluctuation (net heat value, moisture, and ash) which directly impacts burning efficiency and clinker quality. At ACC, kiln specific heat consumption has been impacted directly because of low burning efficiency. High kiln feed LSF requires to take the compensation of high percentages in ash, chlorine, and SO_3 into consideration which increase bypass dust and accordingly specific heat consumption.

ACC identified a breakdown point in kiln specific heat consumption. Dropping below this point would not be economically feasible. Thus, a set of actions had been taken:

- Set kiln and HOTDISC operation parameters that guarantee proper burning efficiency.
- Increase interval of material sampling and analysis to get a closer view of quality.
- Set KPI quality targets with detailed follow-up.

Clinker quality:

Clinker quality control was one of the major challenges for ACC due to above-mentioned RDF quality fluctuation. This issue has been overcome by increasing the interval of sampling and analysis to set proper quality targets.

Kiln feed limitation:

Due to the high moisture of RDF, the amount of combustion gases increased compared to combustion gases of solid fuels. Accordingly, fan speed increased. This constitutes a compromise on whether to decrease kiln feed or alternative fuel utilization.

Material resourcing:

As ACC's alternative fuel substitution target is moving rapidly since the HOTDISC start-up and to fulfil the supply quantity, ACC decided to establish its own subsidiary waste recycling plant (Evolve) to cover 35% of annual consumption. Also, ACC believes that sharing its quality experience with new suppliers supports its development in the Egyptian market.

Material handling and storage

RDF material handling and storage are very important and not easily done. RDF self-ignition, for example, is a common problem if the material is not properly handled and stored with safety precautions.

ACC realized that this risk should be considered to keep steady-state operation as per following:

- The distance between one pile and another should not be less than 10m.
- Access ways between the piles should be clear at all times.
- Pile height must be less than 3m.
- The type of AFR material that will be stored should be accepted by the production department to confirm that it is suitable for usage.
- Loading and unloading of waste material in storage sheds should only be done under the supervision of well-trained staff.
- The person in charge of the AF area will take care of fulfilling all the above requirements at all times.
- Total storage area capacity is around 28,000 m^2.

Reduction of CO_2 Emission

ACC complies with EEAA requirements, which is shown in the CO_2 emission reduction figure (figure 3). The company considers annual KPIs for CO_2 emission reduction that are achieved by identifying the required alternative fuel quantity as well as type of fuel.

Conclusion

Throughout the implementation of alternative fuel systems at ACC, the company found that the main challenge was to institutionalize a cultural change regarding thermal energy. At the early stages, when the implementation was technical-focused, results were not up to the management's expectations. Extensive efforts on capacity building and awareness raising had to be made to build an energy performance focused culture. Combined with the allocation of adequate financial and human resources, the result was a smooth and effective implementation of alternative fuel systems. This demonstrates that management commitment and teamwork are the keys to success.

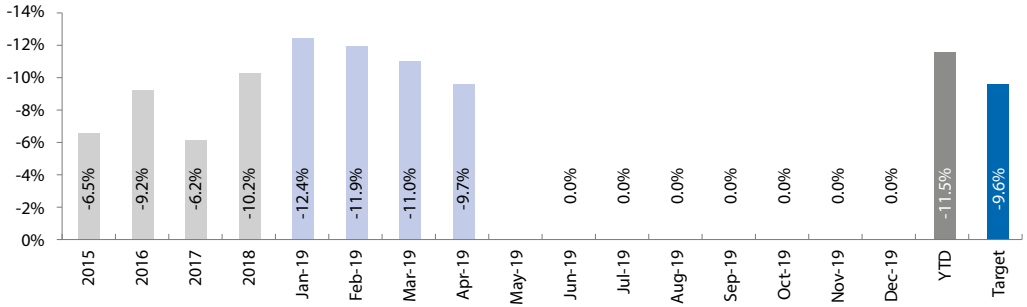

Figure 3: *ACC's CO_2 emission reduction. Source: ACC.*

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Picture 1: Cement plant without dust filters, Syria, 2010. (Source: MVW).

Co-Processing Magazine of Alternative Fuels & Raw Materials

Alternative Fuels: Environmental Regulations and Emission Limits

This abbreviated excerpt from the "Alternative Fuels and Raw Materials Handbook for the Cement and Lime Industry" published by MVW Lechtenberg & Partner, Germany, provides further information about environmental regulations and emission limits, updated according to the latest developments in this area.

Introduction

Alternative fuels, consisting of biomass or refuse-derived fuels (RDF) have been used as a substitute for fossil fuels for over 35 years, especially in the cement industry and also to a small extent in the lime industry. Since strict quality standards are set for cement clinker and lime products, the raw materials and fuels which are fed into the burning process need to be most precisely specified and to be subject to constant monitoring.

Rotary kilns in particular offer the ideal preconditions for recycling alternative fuels at extremely high temperatures, with long residence times and in an environmentally friendly fashion. One of the indispensable prerequisites for this is securing the composition of the alternative fuels in compliance with the prescribed specifications, thereby minimising any possible negative effects on both emissions and end products. Some environmental associations impose strict measures for avoidance of all kinds of detrimental environmental effects resulting from the employment of alternative fuels.

As is widely known, however, detrimental environmental effects cannot be avoided in any combustion process. To minimise these negative impacts, the cement and lime industry has been working on emission-reducing measures for many years. The topic of co-incineration, particularly of waste-derived alternative fuels, has recently become a controversial issue once more. This is due to the 'MATS-regulation' for the cement industry in the US on the one hand and the implementation of the Industry Emission Directive of the EU Commission into German law on the other.

The European Union passed the Industry Emission Directive (IED) in 2010. The IED regulates the integrated avoidance and reduction of emissions produced by the industrial sector in air, water, and soil.

The directive is based on the former Integrated Pollution Prevention and Control Directive (IPPC Directive). It covers some former independent directives, i.e. the Directive on large-scale firing plants, which regulates emissions of power plants, or the Waste Incineration Directive.

The IED came into force on 6 January 2011 and must be implemented into national law within two years. The law providing guidelines and the first omnibus act were concluded by the cabinet in Germany on 23 May 2012 and has come into force in the 17th BImSchV (Federal Emission Control Act) in 2013 [2], which superseded the version from 2009 [1].

Last year, the German cement industry obtained some 67.5% of its need for thermal energy from waste and waste-derived fuels, respectively [15].

This development was possible, among many others, due to an exception clause for the cement industry in Annex II 1.1 of the 17th BImSchV [1]. For total organic carbon (TOC) in particular, exception clauses were granted since TOC emissions mostly result from natural raw materials (e.g. limestone, marl). TOC concentration will have to be controlled more strictly by continuously performing calcination tests on natural raw materials. The same measures would also apply to the alternative raw materials used for clinker production. Table

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

1 shows an excerpt of published emission data from a German cement plant.

After a transition phase, which ended 1st January 2019, NO_x values from clinker production ought to be reduced radically from 500 to 200 mg NO_x/m^3 (stp) [2] – a complicated task since the currently applied SNCR technique (Selective Non-Catalytic Reduction) already results in high costs. The flue gas cleaning systems, which use ammonia or urea, produce further emissions – the ammonia slip, limited to 30 mg/m³ (stp) – and are classified as problematic in many plants at present. However, in the initial draft of the 17th BImSchV, a reduction to 10 mg NH_3/m^3 (stp) was requested but subsequently waived.

An NO_x reduction inevitably results in a higher ammonia slip. Further NO_x reduction can therefore only be achieved by optimising the injection/process control and by feeding higher

Emissions:	Acc. to approval/17. BImSchV, based on [1]	Average concentration
Continuous measurements acc. to § 5a and Annex II 1.1	Emission limit value	Annual average value
Dust	12 mg/Nm³	2.0 mg/Nm³
Sulphur dioxide (as SO_2)	400 mg/Nm³	204 mg/Nm³
Nitrous dioxide (as NO_2)	500 mg/Nm³	478 mg/Nm³
Mercury (Hg)	0.03 mg/Nm³	0.0069 mg/Nm³
TOC (C_{ges})	-	13 mg/Nm³
Individual measurements	Emission limit value	Ø of all individual measurements
Chloride (HCl) acc. to Annex II 1.1	12.0 mg/Nm³	6.2 mg/Nm³
Flouride (HF) acc. to Annex II 1.1	1.4 mg/Nm³	0.07 mg/Nm³
Σ Cd + Tl acc. to § 5 (1) No. 3a	0.05 mg/Nm³	0.0023 mg/Nm³
Σ Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V, Sn acc. to § 5 (1) No. 3b	0.5 mg/Nm³	0.13 mg/Nm³
Σ As, Benzo(a)pyrene, Cd, Co, Cr acc. to § 5 (1) No. 3c	0.05 mg/Nm³	0.009 mg/Nm³
Dioxins/furans acc. to § 5 (1) No. 4	0.1 ng/Nm³	0.0015 ng/Nm³

Table 1: *Excerpt of published emission data at standard conditions of a German cement plant (Source: MVW).*

Reference:	
RDF: Calorific value = 12.09 GJ/kg, moisture = 12.9 %	
1 t of RDF results in flue gas	5,428 Nm³/t (448 Nm³/GJ) at 8.05% O_2 (dry) Air ratio: 1.6
Assumptions:	
400 mg/Nm³ of NO_x (as NO_2) which must be reduced in dry RG to 200 mg/Nm³ of NO_x (as NO_2)	
➔ Reduction	1.09 kg/t 0.084 kg/GJ
Calculations	
Molecular weight	NO_2 46 kg/kmol NH_3 17 kg/kmol
Stochiometry	1.05
Ammonia demand	0.421 kg/t RDF 0.032 kg/GJ
Ammonia water	25 mass %. 1.68 kg/t RDF 0.13 kg/GJ

Scenarios:	Waste with CV of 13 MJ/kg		Waste with CV of 11 MJ/kg	
	kg/t*	kg/GJ*	kg/t*	kg/GJ*
400 to 200 mg	1.68	0.13	1.68	0.15
	2.53	0.19	2.53	0.23
	4.63	0.36	4.63	0.42
	5.48	0.42	5.48	0.5

* kg of ammonia water/t RDF

Table 2: *Calculation of flue gas agent consumption with different emission limit scenarios in an RDF power plant; to reduce NO_x emissions from 400mg/m³ (stp) to 100mg/m³ (stp) approximately 4.5kg/t RDF of flue gas agents at a current value of approximately €1.5 are needed. (Source: MVW Lechtenberg & Partner).*

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Parameter	Limit value before amendment (RDF use >60%)	Limit value before amendment (RDF use <60%)	Limit value acc. to new 17th BImSchV
Dust	10 mg/m³ (d)	20 (d)	10 mg/m³ (d)
NO_x	200 mg/m³ (d)	500 (d)	200 mg/m³ (d)
SO_2	50 mg/m³ (d) [1]	50 mg/m³ (d) [1]	50 mg/m³ (d)
HCl	10 mg/m³ (d)	10 mg/m³ (d)	10 mg/m³ (d)
HF	1 mg/m³(d)	1 mg/m³(d)	1 mg/m³ (d)
Hg	0.03 mg/m³ [2]	0.03 mg/m³ [2]	0.03 mg/m³ (d)
Cd+Tl	0.05 mg/m³ [2]	0.05 mg/m³ [2]	0.05 mg/m³
Sb+As+Pb+ Cr+Co+Cu+ Mn+Ni+V+Sn	0.5 mg/m³ [2]	0.5 mg/m³ [2]	0.5 mg/m³ [2]
TOC	10 mg/m³ (d) [1]	10 mg/m³ (d) [1]	10 mg/m³ (d) [1]
Dioxins/ furans	0.1 TEQ ng/m³ [2]	0.1 TEQ ng/m³ [2]	0.1 TEQ ng/m³ [2]
CO	50 mg/m³ (d) [1]	50 mg/m³ (d) [1]	50 mg/m³ (d) [1]
Source	[1]	[1]	[2]

(d) = Daily average values
(1) Exemptions possible if emissions derive from raw materials
(2) Average of the sampling period
(3) Measurement conditions: Temperature 273K, pressure 101.3kPa, 10% oxygen, dry gas

Table 3: *Comparison of former and new emission limits in Germany.*

amounts of compounds containing ammonia (Table 2). If this is not an option, significant investments have to be made to modernise or upgrade the flue gas cleaning systems from SNCR technology to SCR technology (Selective Catalytic Reduction).

With the implementation of a selective catalytic reduction, the cement industry in Germany reaches the current 'best available technique', meaning that at the moment no further emission reductions are technically possible.

Looking at data from the Pollutant Release and Transfer-Registers (PRTR), it seems that the

Picture 2: *Flue gas agents (SNCR) tanks in Germany, 2012. (Source: MVW Lechtenberg & Partner).*

power generating industry has much better options when it comes to reducing NO_x emissions. The 8 biggest German coal-fired power plants are responsible for two thirds of all NO_x emissions in the German power industry [16]. While new coal-fired power plants achieve NO_x emission levels of 70 mg NO_x/Nm³, the new law only requires 150 mg/Nm³ as a daily average [2].

Lowering limit values (see Table 3), especially for NO_x, would have a severe technical and financial impact on the German cement industry, for this results in retrofitting exhaust gas cleaning with SCR technology requiring high capital expenditures. Depending on cement market conditions and trends in fuel cost development this could lead to a loss in competitiveness of cement plants.

Mercury

In the U.S., the cement industry and all other enterprises using fossil fuels have to observe the MATS-regulations. The new UTILITY MATS act (short for Mercury and Air Toxics Standards), was published on 16 February 2012 as national emission standards for hazardous air pollutants from coal and oil-fired electric utility steam generating units. This not only covers mercury but also dust, SO_2, and HCl.

The radical reduction of emission limit values for facilities is a direct result of the systematic identification of the best technology for flue gas cleaning systems (MACT – Maximum Achievable Control Technology). According to Vosteen and Hartmann [3] coal-fired power plants that

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

are already in operation ought to comply with a limit value (30 day rolling average) of 1.5 µg Hg/m^3 (stp) while a limit value of 25 ng of Hg/m^3 (stp) applies to new plants (both limit values at an O_2 level of 5% by volume). The latter, however, was subject to discussion according to a survey and petition dated 16 April 2012 by the Institute of Clean Air Companies (ICAC), which has more than 100 members amongst US air pollution prevention companies. The petition suggests a noticeably higher, actually measurable limit value of 0.35 µg of Hg/m^3 (at an O_2 level of 5% by volume).

While some countries provide clear emission limit values, as well as regulations on the use of alternative fuels and alternative raw materials, many cement production facilities, particularly in developing and newly industrialised countries, have to lay the groundwork for the substitution of fossil fuels with such alternative materials. Permissible emission limit values vary widely from country to country (compare Table 4). Table 4 also shows ranges of emission values for various cement plants in Germany. The emission ranges within which the kilns operate largely depend on the nature of the raw materials, the fuels, age and design of the plant, as well as on the requirements laid down by the permitting authority.

Parameter	Unit	Pakistan	Philippines	European Union [3]	Germany			
					>60% RDF use [3]	<60% RDF use [3]	Limit in permits	Emission values from kilns in operation
Dust	[mg/m³]	300	150	30 (d)	10 (d)	20 (d)	15 – 20	1 – 15
NO_x	[mg/m³]	400 – 1,200 (depending on fuel)	1,000 (existing plants) 500 (new plants)	800 (d) (existing plants) 500 (d) (new plants)	200 (d)	500 (d)	500 – 800	300 – 600
SO_2	[mg/m³]	400	1,000 (existing plants) 200 (new plants)	50 (d) [1]	50 (d) [1]	50 (d) [1]	350 – 400	100 – 400
HCl	[mg/m³]	400	10	10 (d)	10 (d)	10 (d)	10	0.3 – 5
HF	[mg/m³]	150	50	1 (d)	1 (d)	1 (d)	1	0.1 – 2
Hg	[mg/m³]	10	5	0.05[2]	0.03[2]	0.03[2]	0.03 – 0.05	0.005 – 0.03
Cd+Tl	[mg/m³]		only Cd: 10	0.05[2]	0.05[2]	0.05[2]	0.05	<0.001
Sb+As+Pb+ Cr+Co+Cu+ Mn+Ni+V	[mg/m³]	Pb: 50; Cd: 20 As: 20; Cu: 50 Sb: 20; Zn: 200	Sb: 10; As: 10 Pb: 10; Cu: 100 Ni: 20; Zn: 100	0.5[2]				
Sb+As+Pb+ Cr+Co+Cu+ Mn+Ni+V+Sn	[mg/m³]				0.5 [2]	0.5 [2]	0.05	<0.002
TOC	[mg/m³]			10 (d)	10 (d) [1]	10 (d) [1]	9.2 – 60	
Dioxins/furans	[TEQ ng/m³]		0.1	0.1 [2]	0.1 [2]	0.1 [2]	0.05 – 0.1	0.001 – 0.01
CO	[mg/m³]		500	50 (d)	50 (d) [1]	50 (d) [1]		
Source		[4]	[5]	[6]	[1]	[1]	[8]	[8]

(d) Daily average values

(1) Exemptions possible if emissions derive from raw materials

(2) Average of the sampling period

(3) Measurement conditions: Temperature 273K, pressure 101.3kPa, 10% oxygen, dry gas

Table 4: *Emission limit values (daily averages) in various countries.*

Emissions monitoring

According to the European directive on waste incineration, the emissions of total dust, SO_2, NO_x, TOC, CO, HCl and HF have to be measured continuously in the exhaust gas of co-incineration plants, e.g. a cement kiln that uses alternative fuels. However, the directive provides for certain exemptions and, as a consequence, the requirements can differ from one European country to another [7].

There are two ways to monitor emissions. On the one hand, there are continuous measurements that are made possible by modern analysis devices. Relevant continuous measuring principles are infrared (IR) and ultraviolet (UV) photometry, as well as fourier transform infrared spectrometry (FTIR) and flame ionisation detection.

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

According to the EU directive, the installation and functioning of the automated monitoring equipment has to be monitored by an annual surveillance test. Calibration has to be completed by means of parallel measurements with reference methods at least every three years [7].

The European Cement Research Academy (ECRA), on the other hand, described the so-called individual measurements, which cannot be conducted continuously but only in defined periods. Trace metals belong to this group, as well as dioxins and furans. HF and HCl are subject to periodic measurement only because it has been proven that emission concentrations are very low due to the alkaline atmosphere in the kiln and the preheaters [7].

ECRA goes on to note that all measurements have to follow the provisions of CEN standards or, if CEN standards are not available, according to ISO standards, national or international standards. These procedures should ensure the provision of data of an equivalent scientific quality. During each periodical measurement, it is necessary to determine the relevant exhaust gas parameters. In addition to the gas volume flow, temperature and water vapour of the gas flow, as well as the surrounding pressure and the gas density have to be measured. These parameters are important in determining the total mass flows and in standardising the measuring results to 273 K, 1013 mbar and dry gas [7].

Bolwerk [8] illustrates a further distinction made between first time and repeat measurements, function tests and calibrations, as well as measurements for special reasons, e.g. to determine the emissions of exhaust gas components that are not continuously monitored. The relevant parameters to be considered in measurement planning are derived from regulatory requirements, such as the operating permit, information from the technical supervisory body responsible for the plant and from onsite inspection. All emissions measurement results are related to exhaust gas volume at standard temperature and standard pressure conditions (273 K, 1013 mbar) referred to dry gas and 10% oxygen content.

Continuous measurements are recommended for the following parameters: [8, 9]

- Exhaust gas volume.
- Moisture.
- Temperature.
- Total dust.
- Oxygen concentration.
- NO_x (nitrogen oxides).
- SO_2 (sulphur oxides).
- CO (carbon monoxide).
- Hg (mercury and its compounds).

Undertaking regular periodical monitoring is appropriate for the following substances:

- Metals, metalloids, and their compounds.
- TOC (organic substances).
- HCl (hydrogen chloride).
- HF (hydrogen fluoride).
- PCDD/F (polychlorinated dioxins and furans).

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

Measurements of the following substances may occasionally be required under special operating conditions:

- BTX (benzene, toluene, xylene).
- PACs (polycyclic aromatic hydrocarbons).
- Other organic pollutants (for example chlorobenzenes).
- PCB (polychlorinated biphenyls) including coplanar congeners, chloronaphthalene and others.

ECRA [7] points out that there is a certain increasing tendency to install multicomponent gas analysers within the European cement industry. This development is mainly driven by the fact that European and national authorities keep asking for more components to be monitored continuously. While a few years ago it was sufficient to monitor dust, NO_x and SO_x, nowadays additional components such as TOC also have to be measured. Additionally, the growing development of flue gas abatement techniques leads to further measurement requirements.

Permitting issues

Practice in Germany has shown, that the requirements for permits differ for each plant. These requirements have to be examined and defined as part of the licensing procedure in accordance with local laws and provisions. An environmental compatibility test is compulsory as the alternative fuel project has to be made public. It must be ensured that the project will not have a negative impact on humans, animals or plant life, soil, water, air, the climate or the landscape – including any interactive effects – or on cultivation and property. In such cases, the application for a licence must be accompanied by a description of the local environment and its features, including the anticipated effects of the project on the above-mentioned factors that require protection. An essential component of the environmental assessment analysis (EAA) is the determination and evaluation of the background with the help of limit values and guide numbers, as well as the investigation of harmful effects of pollutants in the plant's sphere of influence. The application for a licence has to provide a comprehensive specification of the operating requirements for the cement plant to ensure safe combustion of the residues, together with a description of the necessary operational measures with regard to the following criteria [8]:

- Calorific value and quantity (kg/h) of alternative fuels used.
- Content of pollutants (e.g. trace elements, chlorine, PCB).
- Information on the identity of the material used.
- Properties of the alternative fuels (physical, chemical, toxic and ecotoxic properties).
- Combustion conditions and destruction efficiency.
- Recirculation systems leading to concentration.
- Possible ways of purging material and relieving the recirculation systems.
- Operating processes with cut-offs (CO cut-off).
- Effect and type of exhaust gas cleaning processes.

Potential faults in the combustion process that could interrupt or alter the flow of material through the rotary kiln are to be documented in detail. Where recirculation processes are necessary, plausible descriptions must be given of measures for the prevention of increased emissions, by way of strategic material purging for example.

Applying for a permit

The use of alternative fuels and raw materials requires the agreement of the appropriate permitting authorities. Depending on the country, in addition to local authorities such as the mayor's office, these can also be state environment bureaus or ministries. Owing to the numerous authorities in charge and the various permitting channels, only the generally valid permitting types and processes are mentioned in this article. Each cement and lime plant should have an open discussion with the pertinent local authorities about the intended alternative fuel and/or raw material project prior to a possible approval process. This discussion should be supported by solid information on the environmental influence in utilising alternative fuels, such as

- General information (e.g. from CEMBUREAU).
- Brochures on the usage of alternative fuels from other plants inside or outside the country.
- A strategy plan of the plant with information on the background of the use of alternative fuels (Why? What is intended? Which materials? When? Who is involved?).

On a global scale, the application for permitting alternative fuel co-incineration is inconsistent. In many countries, the permitting authorities have no knowledge about the use of alternative fuels. Based on experience one should, therefore, expect a certain mistrust and reserve. In other countries, co-incineration of certain alternative fuels or wastes is uniformly approved countrywide and only needs to be notified by the plant's operators. In India, for example, the Central Pollution Control Board released the 'Guidelines on Co-processing in Cement/Power/Steel Industry'. [10] They provide constantly updated information on waste types, which can generally be thermally recycled in the cement industry whilst complying with the published limit values. [11] However, even if the Central Pollution Control Board in India provides such guidelines the local authorities still require different permits such as building permits, etc., which constantly prohibit and delay such environmentally friendly projects in the Indian cement industry.

As a rule, the application process for a permit corresponds to or leans towards the Integrated Pollution Prevention and Control (IPPC) process. IPPC is a regulatory system that employs an integrated approach to controlling the environmental impact of industrial emissions on air,

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

land and water. It involves the determination of the appropriate controls for the industry to protect the environment through a single permitting process. [12] In the context of the regulations, emissions are defined as being the direct or indirect release of substances, heat or noise into the environment from individual or diffuse sources in an installation. IPPC has been implemented to meet the following environmental objectives:

Protection of the environment as a whole by preventing or minimising emissions to all media (air, land and water):

- Encourage reductions in raw materials and energy use as well as increased recycling and reuse.
- Promote the use of clean technology to reduce pollution at source.
- Encourage innovation by leaving significant responsibility for the development of satisfactory solutions to environmental issues with industrial operators.
- Provide a 'one-stop shop' to administer applications for permits to operate.
- Simplify and strengthen the role of the competent authorities (regulators).

To obtain a permit to operate an installation, the operator completes the permit application that demonstrates how they will:

- Ensure satisfactory environmental management of the installation.
- Prevent or minimise waste production.
- Prevent accidents or minimise their effect.
- Ensure that closure of the installation does not leave residual pollution.
- Promote energy efficiency, waste minimisation and management.
- Ensure compliance with other EU directives, community and national environmental quality standards (EQSs) and domestic regulations.
- Apply Best Available Techniques (BAT).

As part of the application process, permit operating conditions are agreed with the regulator and must include:

- Emission limit values for pollutants.
- Measures for the protection of soil and groundwater, as well as management of waste.
- Requirements for monitoring and obligation of the operator to supply the data for checking compliance measures relating to non-standard events such as accidents, start-up conditions or closure of the facility.

The operator must also consider the condition of the site at the time of the original application. This will contribute to assessing the need for restoration if the installation closes. In determining the application, the regulator must be satisfied that the operator has addressed the points above appropriately.

It is the operator's responsibility, therefore, to demonstrate that this is the case. Once the regulator has issued a permit, the operator of an IPPC installation will have to perform monitoring activities to demonstrate compliance with the permit conditions. Regulators will also carry out their own monitoring and inspections, and have a range of enforcement powers. Within the framework of the permitting process, the Environmental Impact Assessment (EIA) plays a central role.

Environmental assessment is a procedure that ensures that the environmental implications of a decision are taken into account before the decision is made. Environmental assessments can be undertaken for individual projects, such as a dam, motorway, airport or factory, on the basis of Directive 85/337/EEC [13] (Environmental Impact Assessment – EIA Directive) or for public plans or programmes on the basis of Directive 2001/42/EC [14] (Strategic Environmental Assessment – SEA Directive). The common principle of both directives is to ensure that plans, programmes and projects likely to have a significant effect on the environment are subject to an environmental assessment, prior to their approval or authorisation. Consultation with the public is a key feature of environmental assessment procedures. The directives on environmental assessment aim to provide a high level of protection to the environment and to contribute to the integration of environmental considerations in the preparation of projects, plans and programmes to reduce their environmental impact. They ensure public participation in decision making and thereby strengthen the quality of decisions.

The EIA Directive (85/337/EEC) [13] has been in force since 1985 and applies to a wide range of public and private projects which are defined in its Annexes I and II: Mandatory EIA. All projects listed in Annex I are considered to have a significant effect on the environment and require an EIA. This includes projects such as long-distance railway lines, motorways and express roads, airports with a basic runway length of ≥2100 m, installations for the disposal of hazardous waste, installations for the disposal of non-hazardous waste – which is the case in most alternative fuel and raw materials projects in the cement and lime industry.

Generally, one can assume that an Environmental Impact Assessment has to be carried out for an alternative fuel and raw materials project in the cement and lime industry.

Even in cases where an EIA is not required by the permitting authorities, the operators should carry out such a process voluntarily. This is time and cost intensive (in general it is estimated to cost around €150,000 plus costs for emission measurements), but it does offer legal security and compliance with CSI Standards. The environmental impact analysis focuses on comparing the expected evolution of the area with and without the implementation of the project. The impact will be addressed in accordance with the operation phases.

Whenever applicable, the various types of impacts will be categorised or classified following the cause of the impact (direct versus indirect) and/or type of impact (positive versus negative, short-term versus long-term, reversible versus irreversible, temporary versus permanent). The

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Picture 3: *Gas probe kiln inlet. (Source: MVW Lechtenberg & Partner).*

Alternative Fuels: Environmental Regulations and Emission Limits

expected environmental issues that are typically associated with the implementation of the proposed project include, but are not limited to the parameters listed below.

Air quality impact (degradation of air quality due to emanation of air pollutants):

- Surface waters and groundwater.
- Introduction of substances into surface waters and groundwater.
- Waste materials, solid wastes and wastewater.
- Quantity and nature of waste materials, solid waste and wastewater produced.
- Natural resources, landscape and visual intrusion.
- Noise and vibration.
- Flora and fauna (loss or disturbance of terrestrial habitats due to construction activities).
- Health and safety of employees.
- Transport and traffic planning.
- Socio-economic impact (increase in job opportunities, for example).

Environmental Impact Assessment studies usually consist of the following:

- Executive summary.
- Definition of existing policies, legal and administrative framework.
- Description of the proposed project.
- Definition and analysis of baseline environmental conditions.
- Identification and analysis of potential types of impact.
- Analysis of alternatives.
- Mitigation plan – protective measures.
- Environmental monitoring plan.
- Environmental management and training plans.
- Public involvement and participation.
- Air quality monitoring methodology.
- Simulation of AFR use.
- Air quality assessment.
- Continuous monitoring of pollutants.
- Authority follow-up and re-evaluation of results.

For the execution of the EIA, cooperating with a local engineering office/specialist is recommended if possible, so that the local network can be used. Employing external, foreign specialist firms or accredited experts of emission measurements is also advisable. For example, the VDZ Forschungsinstitut der Zementindustrie GmbH (Cement Industry Research Institute), Düsseldorf, Germany, offers to perform emission measurements complying with EU Directive 2000/76/EC. Within the framework of the permitting grant, as a rule, conducting burning trials (i.e. test usage of alternative fuels) is performed or requested.

Conclusion

More and more industrialised countries set stricter emission limits according to the 'Best Available Technical Standard'. However, the situation is different in less industrialised and developing nations. Such countries usually have high emission limits, if they have any regulations on emissions at all. Cement companies, mostly cement groups, which do business in these countries, not only comply with but also exceed these laws as they are already subject to stricter values in their corporate sustainability standards than those passed by the respective government. However, certain minimum standards need to be implemented when using alternative fuels and raw materials.

References:

[1] 17. BImSchV – Siebzehnte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über die Verbrennung und die Mitverbrennung von Abfällen) (Ordinance on the Emission Control Law). Germany, 31. January 2009.

[2] 17. BImSchV – Siebzehnte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über die Verbrennung und die Mitverbrennung von Abfällen) (Ordinance on the Emission Control Law). Germany, 02. May 2013.

[3] Vosteen B. W.; Hartmann T. C.: Bromine Enhanced Dry Mercury Capture. 9th Mercury Emissions from

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Coal International Experts Workshop (MEC9), St. Petersburg, May 2012

[4] Pakistan Environmental Legislation and the National Environmental Quality Standards. Government of Pakistan, October 1997.

[5] Guidance Manual on the Use of Alternative Fuel and Raw Materials in Cement Kiln Co-processing. Industrial Technology Development Institute, Department of Science and Technology in cooperation with Cement Manufacturers Association of the Philippines (CeMAP), Inc. Environmental Management Bureau, 2008.

[6] Directive 2000/76/EC of the European Parliament and of the Council of 4. December 2000 on the Incineration of Waste. The European Parliament and the Council of the European Union, Official Journal of the European Communities, 2000.

[7] ECRA – European Cement Research Academy: Waste incineration is subject to tight emission monitoring. ECRA Newsletter No. 3, Duesseldorf 2004.

[8] Bolwerk, R.: Waste Incineration and Emission Control by Cement Plants in Germany. 13th World Clean Air and Environmental Protection Congress and Exhibition in London, 2004. Available at http://www.umad.de/infos/cleanair13/pdf/full_48.pdf.

[9] Leitfaden zur energetischen Verwertung von Abfällen in Zement-, Kalk- und Kraftwerken in Nordrhein-Westfalen, 2. Edition. Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen, Düsseldorf 2005.

[10] Guidelines on Co-processing in Cement/Power/Steel Industry. Cf. Central Pollution Control Board, Ministry of Environment & Forests, Government of India, February 2010.

[11] Some examples: www.cpcb.nic.in/Highlights/2008/chapter-12.pdf (checked in January 2012); www.cpcb.nic.in/divisionsofheadoffice/pci1/Min_third_TF_oil_ref_petrochem.pdf (checked in January 2012); www.cpcb.nic.in/Grainbaseddistilleries.pdf.

[12] Integrated Pollution Prevention and Control (IPPC) – Guidance for the Cement and Lime Sector. Environment Agency, April 2001.

[13] Council Directive 85/337/EEC on the Assessment of the Effects of certain Public and Private Projects on the Environment. The European Parliament and the Council of the European Union, 27. June 1985.

[14] Directive 2001/42/EC on the Assessment of the Effects of certain Plans and Programmes on the Environment. The European Parliament and the Council of the European Union, 27. June 2001.

[15] Verein Deutscher Zementwerke e.V.: Environmental Data of the German Cement Industry 2018, Düsseldorf, Germany, August 2019.

[16] BUND e.V.: Stickstoffoxid-Emissionen aus Kohlekraftwerken, Berlin, October 2018.

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

YOUR EXPERT
IN ALTERNATIVE FUELS

www.lechtenberg-partner.de

Alternative Fuels and Raw Materials Handbook, volumes 1 and 2

Get yours now

because 25 years of firsthand experience is always worth a browse!

VOLUME 1

Contents include among others:

- Background and key issues for investments in RDF production technologies and RDF usage
- Production of RDF & quality control
- Logistics and storage of RDF
- Dosing and feeding of technologies
- Influences on clinker & lime production
- Emission limits

VOLUME 2

Compilation of alternative fuels and raw materials fact sheets including among others:

- Information about origin, composition and availability
- Chemical and physical parameters
- Specific influences on the clinker production process
- Environmental aspects

MVW
LECHTENBERG & PARTNER

Dammstraße 11a, 47119 Duisburg, Germany
Tel: +49 (0) 203 34 65 16 – 25 Fax: +49 (0) 203 34 65 16 – 50 sales@lechtenberg-partner.de www.lechtenberg-partner.de

Picture 1: *Plastic waste contaminated beach, (coast of Gambia). Source: MVW Lechtenberg.*

Co-Processing Magazine of Alternative Fuels & Raw Materials

Our Plastic Oceans

Call for Action to the Global Cement Industry

By Dirk Lechtenberg

Marine litter is a global concern, affecting all oceans worldwide. Every year, millions and millions of tonnes of plastic waste end up in the ocean worldwide, posing environmental, economic and health problems. Poor practices of solid waste management, wastewater (including stormwater) collection and treatment, lack of infrastructure and awareness of the public at large about the consequences of their actions substantially aggravate the situation [1].

Facts and figures

According to the European Commission, approximately 150 million tonnes of plastics have accumulated in the world's oceans, while 4.6 to 12.7 million tonnes are added every year. It is broadly assumed that approximately 80 % of marine litter is land-based, with regional fluctuations (for example, in the Northeast Atlantic, shipping and fishing are very important litter sources) [1].

Marine litter can cause serious economic damage: losses for coastal communities, tourism, shipping, and fishing. Potential cost across the EU for coastal and beach cleaning was assessed at almost €630 million per year, while the cost to the fishing industry

Pictures 3 & 4: *Collection of waste, clean plastic bottles in Kinshasa, DRC. Source: MVW Lechtenberg.*

could amount to almost €60 million [2]. Taking into account its accumulation and dissemination, marine litter may be one of the fastest-growing threats to the health of the world's oceans.

Cleaning up the oceans is, of course, necessary, but not the *solution* to avoid marine litter. An estimated 75 % of the up to 10 million tonnes of waste that end up in our oceans each year are plastics [3]. It could thus be compared to cleaning the desert of its sand – we face a simply impossible and unaffordable task. Thus, we have to tackle the problem at its source.

Marine litter is also one of the clearest symbols of a resource inefficient economy [1]. Valuable materials are polluting our beaches and damaging our environment instead of being led back into our economy. Therefore, a circular economy approach that emphasizes preventing waste, recycling and reuse of materials and products in the first place, is the best solution to the marine litter problem.

The cement industry's influence

With a total clinker production capacity of 4.3 billion tonnes and around 6.000 plant locations around the world, the cement industry has a heat demand equivalent to an estimated 560.000.000 tonnes of coal [4]. Considering this amount, and the fact that fossil fuels are inevitably becoming more expensive and less acceptable with regards to our climate, why not use what the oceans are drowning in?

Plastic waste can either be recycled or, if non-recyclable, used as alternative fuel for clinker production. This is also reinforced by the fact that many cement plants are located nearby the seashore with own terminals for cement and clinker export and/or import, or are connected to nearby sea terminals.

Especially in developing countries, there are no waste collection schemes or proper waste management systems in place. At the same time, the unemployment rate, particularly among the youth, is rising. In some regions in the Middle East and North Africa (MENA) for example, the youth unemployment rate remains stubbornly high at around 30% [5].

Whilst inadequate waste management represents a threat to health and the environment, there are many opportunities from using waste as a resource that are open to those otherwise economically marginalized.

A pro-poor, inclusive approach to improved solid waste management can be a win-win: cleaning the poorest communities, rivers, and beaches and make them a healthier place whilst creating jobs.

To support local initiatives for the collection of such wastes and to support cement plants in using the collected wastes as alternative fuels, MVW Lechtenberg & Partner calls interested parties (municipalities, initiatives, cement plants, etc.) for joining the "Blue River" initiative.

A first project will be carried out by MVW Lechtenberg & Partner in a part of Kinshasa, capital of the Democratic Republic of Congo (DRC), where, together with local NGOs, the collection and processing of mixed waste will be started. This project will be beneficial in three ways: it will clean great parts of the city and prevent plastics from being flooded to the ocean, it will create jobs in recycling and it will provide alternative fuels for the local cement plants.

In the following editions of the Co-Processing Magazine, we will further report on the project and its progress. Parties that are interested to join such an environmental initiative, please contact office@lechtenberg-partner.de.

Sources

[1] European Commission: Our Oceans, Seas and Coasts. Retrieved from https://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/index_en.htm (30 September 2019)

[2] Barry L. Johnson, Maureen Y. Lichtveld: Environmental Policy and Public Health. 2nd edition, CRC Press, 2017.

[3] NABU: Plastikmüll und seine Folgen. Retrieved from: https://www.nabu.de/natur-und-landschaft/meere/muellkippe-meer/muellkippemeer.html (02 October 2019).

[4] MVW Lechtenberg, estimation based on internal calculations.

[5] World Economic Forum: Youth Unemployment. Retrieved from: http://reports.weforum.org/global-risks-2018/youth-unemployment/ (01 October 2019).

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

HELECTOR

HERHOF GMBH

WASTE FOR A GREEN ENVIRONMENT

The piles of waste and the continuous reduction of fossil energy resources rate high among the challenges of our time. At HERHOF in order to cope with them we developed the:

Stabilat® Technology.

It refines waste to a secondary fuel that can be used in your flame.

Herhof GmbH · Kalkgraben 2 · 35606 Solms, Germany
Tel.: +49 (0) 64 42 2 07-0 · Fax: +49 (0) 64 42 2 07-2 33
info@herhof.de · www.herhof.de

Get your business noticed!

1/2 page (138x210 mm)

1/4 page (138x97 mm)

1/1 page (297x210 mm)

Advertise with Co-Processing Magazine!

For further details please contact us:

Tel. +49 (0) 203-34 65 16-0
Fax. +49 (0) 203-34 65 16-50
e-mail: sales@lechtenberg-partner.de

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

NEWS

China

- **World Cement Association emphasizes importance of decarbonization**

Ireland

- **EPA grants licence to burn alternative fuels at Irish Cement's Mungret plant**

India

- **CMA commits to collaborate on waste management**
- **Dalmia Cement aims to be carbon negative by 2040**

Philippines

- **Holcim supports Iligan City in waste management**

Switzerland

- **LafargeHolcim allocates CHF160 million to reduce carbon footprint in Europe**

USA

- **Lehigh Hanson to acquire Keystone cement plant**

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

China

World Cement Association emphasizes importance of decarbonization

The World Cement Association (WCA) is urging the global cement industry to embrace decarbonization and to increase efforts to adopt new technologies faster and put greater focus on innovation in order to make crucial progress on reducing CO_2 emissions.

The third WCA World Cement Conference took place on September 10 in Shanghai. WCA President Song Zhiping emphasized the importance of an industry-wide response to climate change: "WCA supports a sustainable cement industry and encourages technical development and other steps to achieve full decarbonization".

Around 400 delegates heard how the cement sector is making great efforts worldwide to switch to sustainable production methods. These include the use of alternative fuels and artificial intelligence to improve energy efficiency and reduce emissions.

Source: World Cement Association (2019, September 13): "World Cement Association Conference emphasizes decarbonization".

Ireland

EPA grants licence to burn alternative fuels at Irish Cement's Mungret plant

Irish Cement has received green lights from the Environmental Protection Agency (EPA) to burn alternative fuels including, but not confined to, used tyres, plastics and animal waste tissue at its plant in Mungret. The licence grants Irish Cement permission to incinerate 90,000 tonnes of waste annually.

The company plans to replace fossil fuels, as part of a €10 million plan, which it says will result in the creation of 60 new temporary jobs and secure the future of 80 staff working there.

Over 4,500 people from surrounding villages expressed concern over the plans. However, EPA said there were "more than 100 individual conditions relating to the environmental management, operation, control and monitoring of the installation" and added it was "satisfied that the emissions from the installation when operated in accordance with the conditions of the proposed licence will meet all required environmental protection standards and will not endanger human health or harm the environment in the vicinity of the installation or over a wider area".

An Irish Cement spokesperson said: "Irish Cement welcomes today's decision by the EPA to allow for the replacement of fossil fuels in the Limerick cement factory. Irish Cement will study the details of the proposed licence before making any further comment."

Sources: limerickleader.ie (2019, September 18): "Irish Cement gets go-ahead for €10m plant to burn waste", and irishtimes.com (2019, September 19): "Protest planned after Irish Cement gets green light to burn alternative fuels".

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

CMA commits to collaborate on waste management

During 'CONSERVE 2019' conference on alternative fuels and raw materials in New Delhi from September 30 to October 1, the Cement Manufacturers Association (CMA) committed towards disposal of wastes and plastics and use of alternative fuels and raw materials. The Indian cement industry has been able to use almost 75Mt of waste as a replacement of raw materials and fuels, according to CMA President, Mahendra Singhi.

The conference saw members of the cement industry along with other stakeholders including senior government officials and technocrats come together to discuss the role of the cement industry in contributing to India's energy efficiencies.

India's Secretary of Ministry of Housing and Urban Affairs, Durga Shankar Mishra, thanked the cement industry for supporting the Swacchata hi Sewa mission in October 2019 in its second phase by helping dispose of plastic waste in the cement plants within a 200 km radius.

He assured that subsequent to this initiative, the Government is willing to discuss with the cement industry on how to best manage the processing of plastic and waste disposal.

During the conference, Dirk Lechtenberg from MVW Lechtenberg & Partner gave a presentation on the company's experience from international projects on the collaboration for effective waste management systems, addressing topics such as business models for private / public partnerships in alternate fuels and the effects of processing waste into alternative fuels in India.

Source: indiascr.in (2019, October 1): "Cement firms commit to collaborate on disposal of plastics and waste management".

From left to right: Rajnish Kapur, Sujeet Samaddar, Raju Goyal, Bedoshruti Sadhukhan, Dirk Lechtenberg and Sandeep Shrivastava at CMA CONSERVE 2019. Source: CMA.

Dalmia Cement aims to be carbon negative by 2040

Dalmia Cement (Bharat) has been globally ranked no. 1 by CDP (formerly Carbon Disclosure Project) for business readiness of lowest carbon transition. The company also has the lowest carbon footprint in the global cement industry according to Sunil Gupta, Executive Director, Eastern Region.

"We follow the strict regimes and are the greenest cement manufacturing company in the world. Reducing transition risks and creating transition opportunities are the top priorities; emissions and energy intensities directly impact the operating costs and India's Dalmia Cement aims to be carbon negative by 2040," added Gupta.

The company's carbon negative ambition is an attempt to minimise the environmental impacts of cement production in the country. "We are the first cement company across the globe to join RE100 (Renewable Energy - includes wind, solar, biomass and hydropower) and EP100 (Energy Production) - showing real business leadership in the clean energy transition by taking a joined-up approach", said Gupta.

Nevertheless, a transformative technology such as carbon capture and storage (CCS) will be required to realize this ambition, and Dalmia Cement has also announced plans to build a 500,000tpa carbon capture facility at its Tamil Nadu plant within the next 2-3 years. The company is planning to increase the production capacity from 10MT to 16MT by 2021.

Source: Manufacturing Today, Inida (219, September 26): "Dalmia Cement aims to be carbon negative by 2040: Group CEO".

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

Philippines

Holcim supports Iligan City in waste management

Leading cement maker Holcim Philippines, Inc. and its waste management unit Geoycle will help Barangay Poblacion of Iligan City manage its municipal wastes in a sustainable and environmentally sound manner. Qualified materials will be used to produce low-carbon fuels for cement manufacturing.

Under the partnership, the local government of Barangay Poblacion will send residual wastes such as plastics, laminates, textiles, and rubber to Holcim's Misamis Oriental plant in Lugait, for pre- and co-processing of non-hazardous and low-moisture residual wastes such as plastics, laminates, textiles, and rubber. Geocycle will also extend technical assistance and training on proper waste segregation and packaging to employees of Barangay Poblacion's materials recovery facilities.

"We believe that co-processing is an effective and sustainable tool in addressing the waste management challenges of the country. Holcim Philippines is committed to further developing partnerships with local governments and raising awareness about the advantages of co-processing to further raise our contribution to lessening wastes that go to landfills," said Holcim Philippines Vice President for Geocycle, Frederic Vallat.

Source: Holcim (2019, September 19): "Holcim to help Iligan City in waste management".

Switzerland

LafargeHolcim allocates CHF160 million to reduce carbon footprint in Europe

LafargeHolcim is increasing its efforts to further improve the carbon-efficiency of its products and solutions. The objective is to reduce annual CO_2 emissions in Europe by a further 15 percent like-for-like, representing 3 million metric tonnes, by 2022. This will be achieved with an investment of CHF160 million into advanced equipment as well as technologies to increase the use of low-carbon fuels and recycled materials in the company's processes and products. Over the next three years, LafargeHolcim will work on more than 80 projects across 19 European countries.

Marcel Cobuz, Region Head Europe: "We are cognizant of our impact on the environment and will remain at the forefront of efforts to mitigate climate change. […] We are not only investing to reduce CO_2 in our own operations, but are also seeking the collaboration with our customers across the value-chain to improve the carbon efficiency of buildings and infrastructure throughout their lifecycle."

One of the key levers to improve carbon-efficiency is to integrate the principle of circular economy into the cement production process by using waste materials instead of fossil fuels and primary raw materials. In 2018, LafargeHolcim repurposed 11 million tonnes of waste materials, including 2 million tonnes of non-recyclable plastics that would otherwise end up in landfills, for example, creating further CO_2 emissions. By stepping up its efforts in Europe, the company aims at repurposing an additional 1.5 million tonnes of waste which would lead to avoiding 1 million tpy of CO_2.

As part of the roadmap, LafargeHolcim will also increase the use of mineral alternatives and waste materials. On average, LafargeHolcim already uses 4.5 million tonnes to replace clinker with by-products from other industries. It is during the production of clinker, the main component of cement, when most CO_2 emissions associated with cement occur. Additional efforts to replace clinker will allow the company to increase the CO_2 efficiency of its cements produced in Europe by 1 million tonnes.

Source: Lafarge Holcim (2019, September 18): "LafargeHolcim allocates CHF 160 million to reduce carbon footprint in Europe".

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH | Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg

USA

Lehigh Hanson to acquire Keystone cement plant

HeidelbergCement has announced that its north American subsidiary, Lehigh Hanson Inc., will acquire the 1.1 million tonne per year capacity Keystone cement plant in Bath, Pennsylvania, from Giant Cement, a subsidiary of Mexico's Elementia S.A.B. de C.V.. The agreed price is US$151 million, equivalent to US$137/t of capacity.

"With its modernized kiln, healthy customer base and large limestone reserves, the Keystone cement plant is an excellent strategic fit for HeidelbergCement in North America and an important step in strengthening our cement footprint in this key market," says Dr. Bernd Scheifele, chairman of Lehigh Hanson parent HeidelbergCement. "The acquisition of one of the most modern and environmentally sustainable cement facilities in the United States will further help Lehigh Hanson reduce its carbon footprint by safely substituting alternative fuels for traditional fossil fuels such as coal. In addition, we anticipate a number of operational efficiencies as a result of this transaction."

A Lehigh Valley fixture since 1928, the Keystone plant runs a kiln upgraded in 2009 and supplies the Pennsylvania, New Jersey and New York markets with bulk and bagged portland cements.

Source: Concreteproducts.com (2019, September 30): "Lehigh Hanson strengthens Mid-Atlantic footprint with Keystone".

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, 47119 Duisburg Ruhrort, Germany | VISDP/Editorial Director: Dirk Lechtenberg

www.lechtenberg-partner.de

YOUR EXPERT
IN ALTERNATIVE FUELS

Learn more about our fields of expertise:

Feasibility studies & audits

- Energy efficiency audits
- Waste assessment
- Technical due diligence
- Impact of RDF utilisation on clinker production
- RDF quality and substitution rates
- Environmental impact assessment
- Audits of cement and RDF plants

RDF project development & implementation

- Technical concepts for the co-incineration of alternative fuels and biomass
- Waste processing technologies
- Dosing and feeding technologies
- Development of quality management systems
- Assistance in operation & quality monitoring

RDF supply & services

- Sourcing and contract management

In-house alternative fuels workshops

- Tailored to local plant's requirements and needs of internal audience

Alternative Fuels and Raw Materials Handbook

- The most comprehensive compendium of the alternative fuels and raw materials on the market

MVW
LECHTENBERG & PARTNER

Dammstraße 11a, 47119 Duisburg, Germany
Tel: +49 (0) 203 34 65 16 – 25 Fax: +49 (0) 203 34 65 16 – 50 office@lechtenberg-partner.de

Published by:
MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH

Geschäftsführer Dirk Lechtenberg
Dammstr. 11a, D – 47119 Duisburg
VISDP: Dirk Lechtenberg
Editorial Director: Dirk Lechtenberg

Tel. +49 (0) 203-34 65 16-0
Fax. +49 (0) 203-34 65 16-50
e-mail: info@lechtenberg-partner.de

www.lechtenberg-partner.de

MVW
LECHTENBERG & PARTNER

Co-Processing Magazine of Alternative Fuels & Raw Materials

by MVW Lechtenberg & Partner, Germany

Published by: MVW Lechtenberg Projektentwicklungs- und Beteiligungsgesellschaft mbH
Dammstrasse 11a, D – 47119 Duisburg Ruhrort, Germany
VISDP: Dirk Lechtenberg | Editorial Director: Dirk Lechtenberg