Co-Processing Magazine
of Alternative Fuels & Raw Materials

01
2021

Publication of MVW Lechtenberg & Partner, Germany

Image: Wind turbines in Australia

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Contents

It has now been over a year since the COVID-19 pandemic hit our lives, suddenly and with full force, and I can say that I had not expected it to have such a longlastic impact. In Germany, we have been more or less in a second lockdown since the end of October.

What has most surprised me was not the general impact the virus had on our everyday live. It is the fact that after one year of the crisis, one of the most advanced countries in Europe still has not found a way to handle it more efficiently than with a lockdown.

The mismanagement of the vaccine planning and distribution, the lack of any perspective for small business owners, the event industry and gastronomy, and almost a full year of education lost to children and students are some of the consequences. At the bottom of these issues lay an over-bureaucracized system and an underdeveloped digital network. They have paralyzed our country and government.

Sure, the pandemic came fast, but Germany knew what to expect from seeing the crisis evolve in other countries first, such as in China, or Italy.

Seeing our democratic country and system react so slowly to the threat of the virus is alarming. One would have thought that in the face of such a crisis, our systems could react faster.

So what can we learn from this? Our systems need to be more flexible, react more agile. We should be open to change

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Dear Readers,

and adapt to it a lot faster. We should not be generally critical to all changes, we should embrace change and drive innovation. Not at any cost of course, but the investment should outweigh the potential risk the crisis exposes us to.

And this is also the way to go with climate change. Even if it feels not as immediate to some of us yet, as it is for others – just like we saw the virus evolve in other states first – this is the time to prepare, to counteract, to avert and to adapt. Faster than we have in the last few decades.

While curating this issue, we were glad to see a lot more news of positive changes in the alternative fuels community compared to two years ago. The topic is becoming more and more relevant, and this is a great sign.

A nice example of how the positive change becomes visible has been witnessed by one of my colleague's daily commute to work. Every day she passes an onshore windpark twice, for about two years now. She has seen a new wind turbine being erected almost every second month. It might be arguable if it is an improvement for the landscape, but it will surely improve our sustainability advancements.

However, every wind turbine will at some point have to be dismantled. Read more about opportunities for co-processing of wind turbine blades in the cement industry starting from page 09 in this edition of the Co-Processing Magazine.

With standard pre-calciners, the combustion of alternative fuels is demanding. The waste needs to be pre-processed to be fine and light, otherwise it will not be suspended in the gas flow and fall down into the kiln inlet. On the other hand, it requires long pre-calciners to provide sufficient residence times to ensure a proper fuel burnout. Instead, alternative fuels can be treated thermally in combustion chambers, that can be attached to pre-calciners. Stephan Pallmann, Head of Process & Quotation and Samuel Zühlsdorf, Product Manager at thyssenkrupp Industrial Solutions AG, give an overview of the first installation of a prepol® SC-S at a riser duct kiln at Cementos Artigas in Minas, Uruguay, starting from page 16.

As for our new alternative fuels production site, Blue River Recycling Ems, we are proud to have completed the erection! The combined heat and power plant will start by the end of April, and cold commissioning will soon begin – all during the pandemic, thanks to outstanding efforts from our team and partners.

Upon popular request, we hope that the new format of our Co-Processing Magazine and the access through the e-reader will enhance your reading experience even more.

Enjoy reading this edition!

Yours faithfully,

Dirk Lechtenberg

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Our Plastic Problem – from Pollution to Potential

By Dirk Lechtenberg, MVW Lechtenberg & Partner

A while ago, I came across an interesting article about plastic waste, published by the European Environment Agency (EEA) and titled "reducing loss of resources from waste management is key to strengthening the circular economy in Europe" [1].

The article was mentioning that valuable resources are lost during waste management due to "inefficient waste collection, consumer behaviour and a lack of awareness, market-related aspects, technological barriers, design complexities and the hazardous nature of embedded materials."

To me, this seems comprehensible, especially with regard to the variety of packaging that consists of two, three or more different types of materials, or plastic toys with several parts. How should a consumer know which parts consist of which materials and how to correctly recycle or dispose of these?

The article furthermore mentioned that in Europe, only a small proportion of waste is collected and recycled. Several types of waste and their treatment in Europe have been portrayed, and the given numbers are alarming: in total, of 130 million tonnes of **e-waste** generated in the EU in 2015, only 40% have been collected. What's left is the bigger proportion: 60 % of these wastes are "lost".

Of 1.9 million tonnes of **batteries** generated in EU each year, only 46% are collected and recycled, and again, the remaining 54% are "lost".

Even **textiles** (and I assumed that almost all textiles are reused or recycled): Of the produced 5.6 million tonnes in 2015, only 20% have been collected and recycled.

At the bottom of this devastating list are plastics. Of the annually generated 30 million tonnes of plastics, only 17%

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are collected and recycled. The majority of 83% of all produced plastics are “lost”.

Every tonne of plastics we do not recycle but deposit or burn is irretrievably taken from the raw-material cycle. However, in the article it is not differentiated between landfilling and energy recovery. This led me to the question: What is the impact of using not recyclable plastics as alternative fuels for the cement industry, and thereby reducing fossil fuels use?

After I had slowly recovered from the shock to know that only 17% of plastics produced in Europe are actually recycled, I wondered what this amount would be globally.

In 1950, the world produced 2 million tonnes of plastic per year. Since then, annual production has increased nearly 200-fold, reaching 359 million tonnes in 2018 [2]. In total, since the development of plastics in the 50ies of last century, the world had produced 7.8 billion tonnes of plastics (polymer resin and fibre). **This equals one tonne of plastic for every person alive today.**

To break this up into more detailed numbers, have a look at figure 1:

- By 2015, cumulative production of polymers, synthetic fibres and additives was 8.3 billion tonnes;
- 2.5 billion tonnes (30%) of primary plastics were still in use in 2015;
- 4.9 billion tonnes (59%) went straight to landfill or was discarded;
- 700 million tonnes (1%) were incinerated;
- 500 million tonnes (0.6%) were recycled (100 million tonnes of recycled plastic were still in use; 100 million tonnes were later incinerated; and 300 million tonnes were later discarded or sent to landfill).

Of the 5.8 billion tonnes of primary plastic no longer in use, only 0.8% have been recycled since 1950.

Coming back to the European report about “reducing loss of resources from waste management”, I found that a recycling rate of 17% within Europe is not high, however, better than a worldwide recycling rate of 0.8%.

I was curious to see which countries are responsible for the highest rates of plastic production – and therefore waste production.

When examining the numbers, it is obvious that the higher the per capita income of a country, the more plastic waste is generated.

In the map in figure 2 we see the per capita rate of plastic waste generation, expressed as kilograms per person per day.

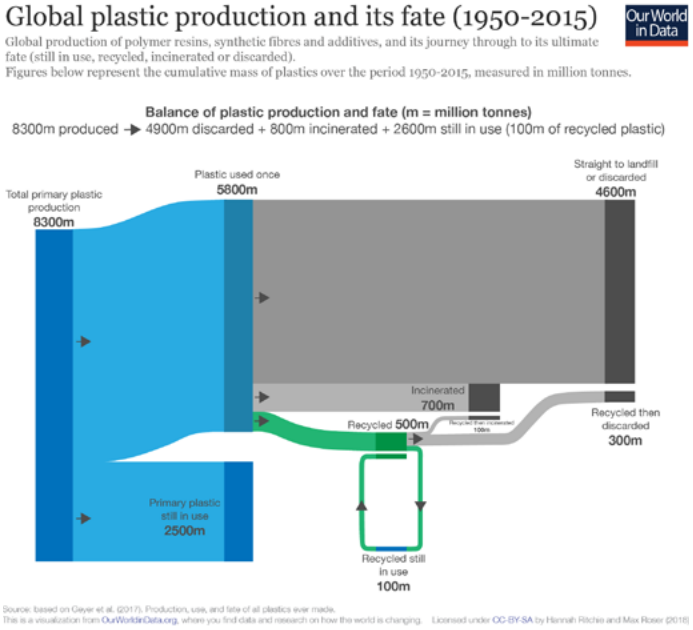

Figure 1: *Global plastic pollution and its fate. (Source: https://ourworldindata.org/plastic-pollution)*

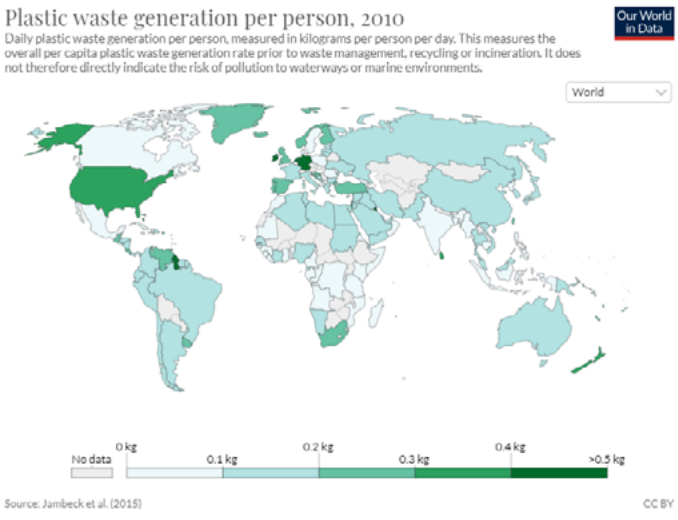

Figure 2: *Plastic waste generation per person in 2010. (Source: https://ourworldindata.org/plastic-pollution)*

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We see that daily per capita plastic waste generation across the higher ranked countries – Kuwait, Guyana, Germany, Netherlands, Ireland, New Zealand – is up to five times higher than across many countries such as India, Tanzania, Mozambique and Bangladesh.

Aside from the "high" aspiration to maintain plastic as a raw material by recycling it, on a lot of my travels to developing and emerging countries I see the primary goal of establishing a functioning waste collection and treatment system. Too many times I have seen heaps of waste at the roadside which were just lit to burn down or disposed of in rivers.

Inadequately disposed of waste is not formally managed and includes disposal in dumps or open, uncontrolled landfills, where it is not fully contained. Inadequately managed waste has high risk of polluting rivers and oceans.

High-income countries, including most of Europe, North America, Australia, New Zealand, Japan and South Korea have very effective waste management infrastructure and systems at hand. This means that discarded plastic waste (even that which is not recycled or incinerated) is stored in secure, closed landfills. Across such countries almost no plastic waste is considered inadequately managed. However, this does not mean there is no plastic at risk of entering the natural environment.

In contrast to this, across many countries in South Asia and Sub-Saharan Africa, between 80 to 90% of plastic waste is inadequately disposed of, and therefore at risk of polluting rivers and oceans.

How could this issue be resolved?

We see that in these countries, the loss of resources from such plastics is much higher than in Europe. Not only are recyclables not used or recognized as alternative fuel, they are mostly not collected and thus pollute the natural environment, rivers and oceans.

That is something I frequently see during my travels, hence the selection of countries in figure 3. At the same time, I see many scavengers picking recyclable materials from the waste piles, such as carton, metals, clean and homogenous plastics (PET / PE bottles), in a quite effective manner.

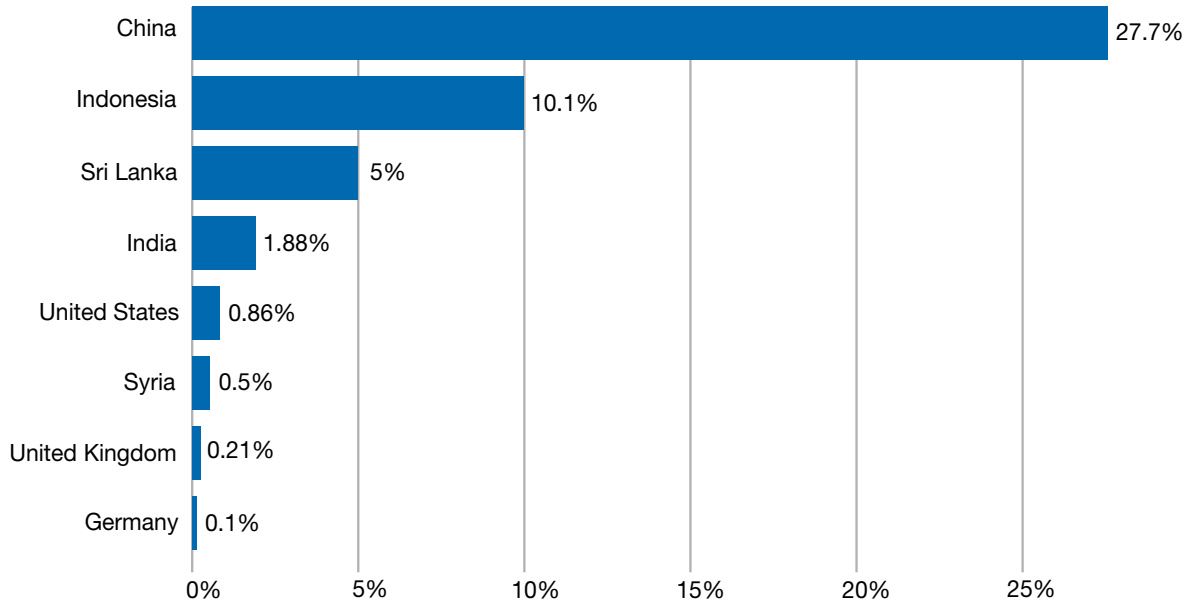

Figure 3: *Share of plastic waste that is inadequately managed as of 2010. (Source: Source: https://ourworldindata.org/plastic-pollution)*

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Figure 4: *Landfilled waste next to a river in Lahore, Pakistan.*

Figure 5: *Scavengers separating plastics at a landfill in Albania.*

Nevertheless, a huge amount of plastic wastes remains untouched, which would be perfectly suited as alternative fuel for the cement industry. In most cases, a lack of infrastructure lays at the core of this problem. No collection of wastes, no treatment and shredding, no alternative fuel.

Doesn't it seem paradox, especially given the billions of Euros, Dollars, Rupees and money in the world spent on fossil fuels like oil and coal in the industry? Even more so since these increase the immense fossil CO_2 pollution this planet is already suffering from? Around 5 – 8 % of global CO_2 emissions are attributed to the cement industry which are – unfortunately – only partly reducible by alternative fuels use.

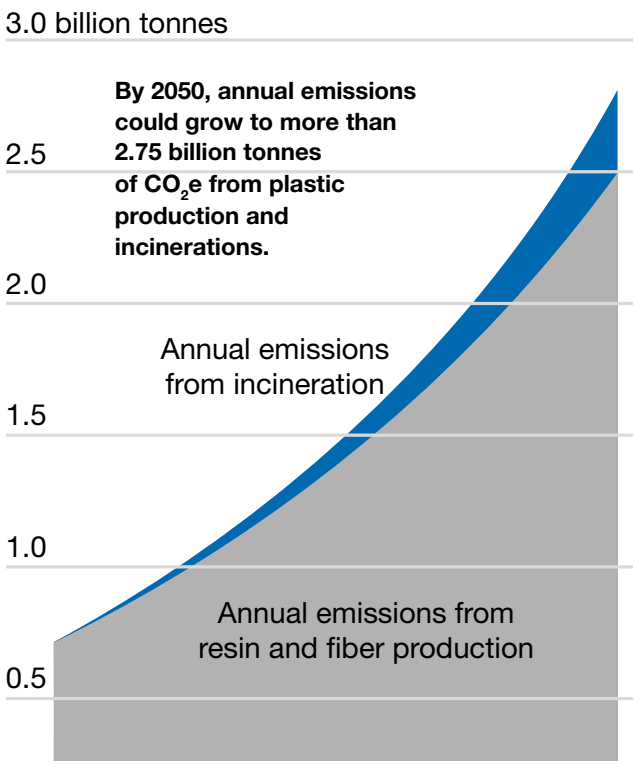

Figure 6: *Annual plastic emission to 2050 (estimated) in billion metric tonnes. (Source: www.ciel.org).*

It is also important to mention that in 2019, global CO_2 emissions from the production and use of plastic materials were around 850 million tonnes, equal to the emissions of 189 500MW coal power plants. The production alone, depending on the process, raw materials and energy used, emits around 0.90 tonnes of CO_2 per tonne of plastic produced and up to 1.89 tonnes of CO_2 per tonne of plastic resin.

According to the Center for International Environmental Law (CIEL), manufacturing accounts for roughly 98% of total direct CO_2 emissions from the industrial sector, with most of these emissions arising from the chemical reactions and fossil fuel combustion needed to produce the intense heat needed for these reactions. These emissions are dominated by a handful of energy-intensive, high-emitting industries, including chemicals and petrochemicals, iron and steel, cement, pulp and paper, and aluminium.

Thus, the question arises whether it makes sense to build waste-to-energy plants which burn wastes with low energy efficiency and emit high amounts of CO_2. Wouldn't the not-recyclable plastic be much more useful as a replacement for fossil fuels in cement plants?

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Fuel substitution calculation			
	Calorific value [kcal/kg]	Substitution factor CV coal	Substitution factor CV petcoke
Plastics	7,000	0.87	1.17
Coal	6,100	1	-
Petcoke	8,200	-	1

Table 1: *Potential substitution of coal/petcoke by plastics waste. (Source: [3]).*

Table 1 shows an economic calculation of plastic which is based solely on the respective net calorific values in comparison with petcoke and coal.

Taking into consideration an average calorific value of around 7,000 kcal/kg, around 0.87 to 1.17 tonnes of plastics can substitute one tonne of coal and one tonne of petcoke, respectively.

Biomass-CO_2-value

Plastics in general cannot be taken into account for fossil CO_2-reduction calculations. This is owing to the fact that their origin is mineral oil. Only bioplastics can be valuable for this.

Nonetheless, plastics can help mitigate greenhouse gas emissions when substituting coal. A simple calculation can reveal the interrelationship:

	Unit	Coal	Plastics
Net calorific value	[kcal/kg]	6,100	7,000
Net calorific value	[MJ/kg]	25.54	29.31
Emission factor	[kg CO_2/GJ]	96	75
Substitution factor fuel		1	0.87
Equivalent CO_2 emission	[kg CO_2]	2,452	1,912
Difference in	[kg CO_2]		539
Difference in	[%]		22%

Table 2: *Appraisal of the CO_2 emission from coal substitution by plastics. (Source: [3]).*

The calculation shows the following: According to the default emission factors from the Intergovernmental Panel on Climate Change (IPCC) as well as from the World Business Council for Sustainable Development, the emission factor of coal is higher than that of plastics. Taking into consideration the substitution factor from table 1, the fossil CO_2 emission for an equivalent heat proportion is even lower. Thus, plastics can help mitigate fossil fuel-derived emissions.

Conclusion

To me, it is alarming how many plastics each one of us consumes on a daily basis. According to numbers from the CIEL report, this amount will continue to rise with increasing wealth in emerging countries. To see that only 17% of plastic wastes in highly "developed" Europe are recycled devastates me and is a sign of our incompetence and lack of effort.

It is about time for all of us to significantly reduce our plastic consumption. And we are capable of doing it. Additionally, the manufacturers and legislators have to take responsibility and only allow for recyclable plastics to be produced and used. Even for single-use products such as food packaging.

Additionally, cement manufacturers could – and should! – increase their efforts of using plastic wastes as alternative fuel. This would not online decrease the industry's CO_2 emissions; it would also generate jobs for waste picking and sorting.

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[1] European Environment Agency (EEA), 28 October 2019: "Reducing loss of resources from waste management is key to strengthening the circular economy in Europe". Retrieved from https://www.eea.europa.eu/themes/waste/waste-management/reducing-loss-of-resources-from

[2] Plastics Europe, 14 October 2019: "Plastics - the Facts 2019". Retrieved from https://www.plasticseurope.org/application/files/9715/7129/9584/FINAL_web_version_Plastics_the_facts2019_14102019.pdf

[3] Lechtenberg, D., & Diller, H. (2012). Alternative Fuels and Raw Materials Handbook for the Cement and Lime Industry.

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Co-Incineration of Wind Turbine Blades

By Marie Lechtenberg, MVW Lechtenberg & Partner

The strive for sustainable energy resources has led to an increase of wind turbine installations worldwide, especially since the turn of the millennium. Wind turbines are becoming an increasingly important source of renewable energy and are used by many countries as part of a strategy to lower costs and reduce their reliance on fossil fuels. Today, on a global scale, the installed wind turbines could provide around 650,559 MW of electricity [2].

But not only the number of wind turbines has increased since, they have also grown in size, as larger turbine blades produce more energy: according to the circular formula, doubling the rotor blade length results in a quadrupling of the rotor area. In Germany, for example, the diameter of newly constructed plants was mostly less than 50 meters until the end of the 1990s; after around 2003 it was mostly between 60 and 90 meters [7]. By 2018, the average rotor diameter grew to 118 m, the average hub height to 132 m and the nominal power to around 3 - 4.5 MW, depending on local wind conditions and speed [8]. Nowadays, mostly three bladed wind turbines are in use.

With this mass of wind turbine blades that has accumulated in the past 20 years, their recycling has recently become a major concern, as wind turbines are designed to have a lifetime of 20-25 years, with some now reaching up to 35 years through lifetime extension [3].

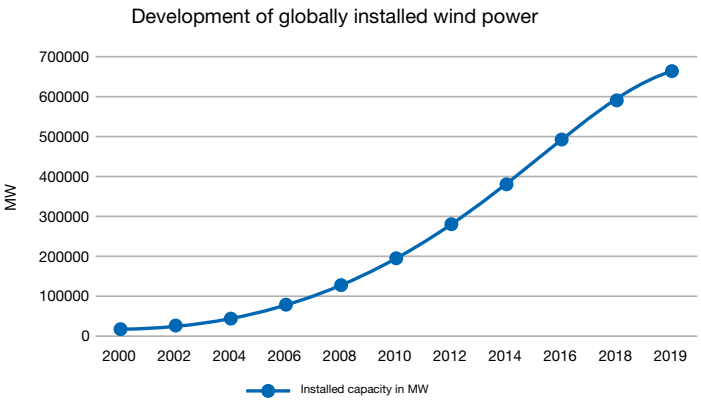

Figure 1: *Development of globally installed wind power in MW. (Source: [2])*

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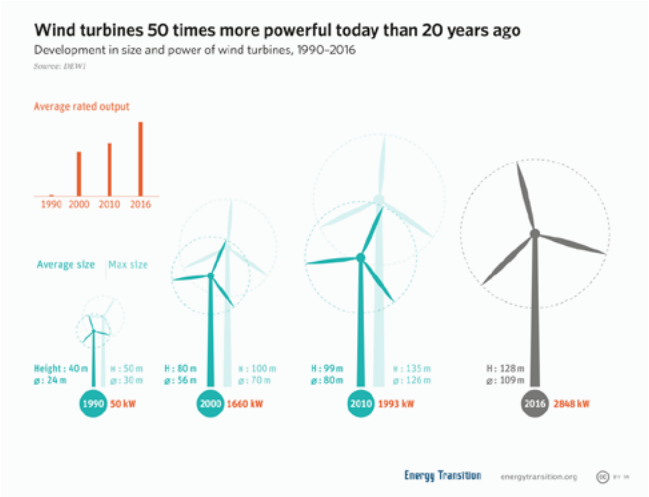


Figure 2: *Development in size and power of wind turbines, 1990 – 2016. (Source: [9]).*

In the U.S. alone, about 8,000 blades will be removed in each of the next four years. Europe, which has started using wind power on a larger scale earlier, has about 3,800 wind mill blades coming down annually through at least 2022 [4].

Thus, a sustainable process for dealing with wind turbines at the end of their life is required to maximize the environmental benefits of wind power. Most components of a wind turbine, such as foundation, tower, components of the gear box and generator are already recyclable. Nevertheless, wind turbine blades represent a challenge due to the materials used and their complex composition.

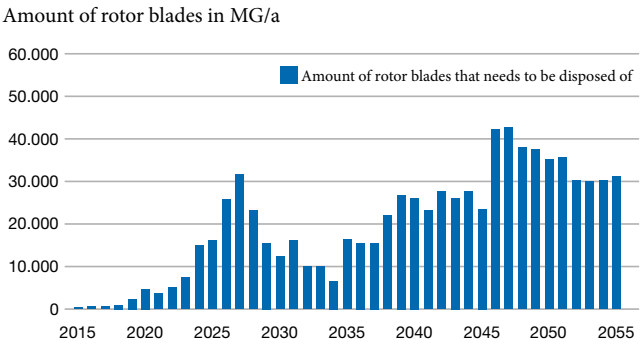


Figure 3: *Arisings of windmill blades in Germany that need to be disposed of. (Source: [5])*

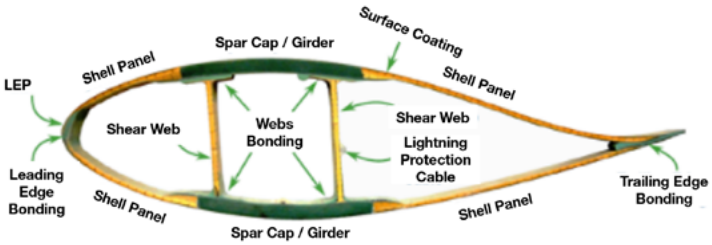
Components and Blade Materials

According to the European classification of wastes, composite blade waste is most often categorised as plastic waste from construction and demolition with the code 17 02 03. The following other codes are also used at national level:

10 11 03	waste glass-based fibrous materials from thermal processes
10 11 12	Waste glass other than those mentioned in 10 11 11 from thermal processes

Wind turbine blades are made of composite material, consisting of various materials with different properties. Although material compositions vary between blade types and blade manufacturers, blades are generally composed of the following (see Figure 1) [1]:

- Reinforcement fibres e.g., glass, carbon, aramid or basalt;
- Polymer matrix e.g., thermosets such as epoxies, polyesters, vinyl esters, polyurethane, or thermoplastics;
- Sandwich core e.g., balsa wood or foams such as polyvinyl chloride (PVC), polyethylene terephthalate (PET);
- Coatings e.g., polyethylene (PE), polyurethane (PUR);
- Metals e.g., copper wiring, steel bolt



Spar Caps/Girders: Unidirectional (UD) Glass/Carbonfibre, supported by Epoxy, Polyester, Polyutherane or Vinylester matrix
Shear Webs and Shell Panels: Multiaxial GFRP Sandwich laminates using Balsa/PVC/PET as core material and Epoxy, Polyester, Polyutherane or Vinylester as matrix systems
Leading/Trailing Edge and Webs Bonding: Epoy/Polyutherane based structural adhesive
Lightning Protetion Cable: Aluminium or Copper
Surface Coating: Polyutherane based lacquer
LEP (Leading Edge Protection): Polyutherane based lacquer/tape

Figure 4: *Cross-section of a rotor blade. (Source: [1]).*

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Figure 5: *Fragments of wind turbine blades being landfilled in Wyoming, USA. (Source: Bloomberg).*

The stiffness of the different composites is determined by the stiffness of the fibres and their volume content. The typical materials that the blades are made of are glass and carbon fibres.

Carbon fibre has a more tensile strength, higher stiffness and lower density than glass fibre. A 100m glass fibre blade weighs up to 50 metric tonnes, while using carbon fibre saves 20% to 30% weight, which would equal about 15 metric tonnes. However, as carbon fibre is around ten times more expensive, mostly glass fibre is used [11]. The basis of textile-grade glass fibres is silica, SiO_2. In general, the glass composites for wind turbine blades contain up to 75% glass by weight [10].

Depending on the manufacturer and type of windmill blade, other fibres can also be used, such as

- aramid and basalt fibres – high mechanical strength, but low compressive strength, low adhesion to polymer resins, absorb moisture, and degrade due to the ultraviolet radiation;
- hybrid composites – such as a carbon and glass mixed fibre;
- natural fibres – like sisal, flax, hemp, jute which come at low costs, high availability and environmental friendliness but variate in quality, have a high moisture uptake and low thermal stability [11].

While most blades are largely made up of glass fibre reinforced plastic (GRP), a large number of blades has also been put into service using other liquid resins including polyester and vinyl-ester.

Recycling of Windmill Blades

Wind turbines in general already have a recyclability rate of 85% to 90% [12]. The challenge in recycling the blades is related to the composite materials. Once the GRP composites have hardened, it cannot be thermally separated again (melted down) [10]. Thus, the remaining options are to either reuse the blade and the composite material elements as they are, to landfill the blades, or to transform the composite material into a new source of material or energy.

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If the latter is chosen, further difficulties arise even before the processing of the actual blades. First, the turbine needs to be disassembled, and the long blades need to be transported with heavy trucks. Additionally, for every wind turbine blade, the design and the arrangement of its elements as shown in figure 4 are different. To separate the different elements, the location of each element needs to be known and a saw with diamond blade and sufficient water cooling is required. Then, as the blades have been exposed to varying environmental influences, they will be found in various conditions. As a consequence, the quality of the material in the blades and the quality of the blade structure will strongly vary from blade to blade.

Interest in recycling blades varies in different markets and depends on the waste legislation and local economics.

Co-Processing in Cement Plants

The option that is currently seen as the most sustainable one is the use of the windmill blades for co-processing in a cement plant. Already in 2005, LafargeHolcim has been asked by a wind turbine manufacturer to employ decommissioned blades in their plants. In 2008, Geocycle launched the full-scale development of the solution in the Lägerdorf cement plant, Germany.

In order to co-process the wind turbine blades, they first need to be cut into segments and will subsequently be shredded into smaller pieces, with a final length of some millimetres. Gravity separators and air classification separators will sort the shredded pieces by size. These particles are usually fibrous, but some have the consistency of powders. After grinding the material, the crushed blade dust is finally added to the existing fuel mix, to create a more homogenous substrate and to bind together the blade dust. At a kiln temperature around 900 °C the resin burns, transforming the blade fibres into ashes [16].

By co-processing the blades, the cement raw materials are being partially replaced by the glass fibres and fillers in the composite, and the organic fraction replaces coal as a fuel. Through that process, the CO_2 output of the cement manufacturing process can be significantly reduced by up to 16 % (if composites represent 75 % of cement raw materials) [13].

The useable thermal energy content of a rotor blade is 14 MJ/kg, which equals approximately half of that of hard coal.

Figure 6: *GRP waste. (Source: [18]).*

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Furthermore, the accrued ashes of the blades are going together with the calcinated raw materials in the sintering zone of the cement kiln. The raw material and the ashes react together at around 1,450°C to form specific mineral components. To get the right clinker quality, an exact composition of silica, iron, calcium and alumina oxide is required, as the chemical properties of the raw materials and the ashes have to be balanced. Rotor blades have a very high ash content of around 50%. This ash consists mainly of silica- and calcium oxide and due to this, natural resources like chalk and sand can be saved [14].

Just recently, in December 2020, GE Renewable Energy signed an agreement with Veolia to recycle its onshore wind turbine blades in the United States. Once removed from the wind turbines, the blades are shredded at a Veolia plant in Missouri. The resulting material will then be used in the kilns to replace the coal, sand and clay needed to make cement. More than 90% of the blade will be reused: 65% as raw material in the cement plants, and 28% transformed into energy required for the chemical reaction in the kiln [15].

In order to create a more homogenous fuel for cement plants, a facility in Germany is recycling glass fibre polymers from wind turbine rotor blades in a multi-stage process. The plant breaks down the blades and then combines them with paper production residue to create a raw material for cement. First, a shredder gradually breaks down the glass fibre components until they are the size of shredded paper. Then they are mixed with paper production residue generated during waste paper recycling, such as plastic labels, plastic bands and packaging materials, all of which cannot be used in paper production. Then, the mixture is turned into a fine granule that makes an ideal additive for cement production.

At the moment, the company has the capacity to process 30,000 tonnes of glass fibre annually. According to the company itself, the produced additive has a defined and controlled calorific value, has a dry matter content of usually over 65 %, achieves a grain size or around and below 35mm and is modifiable according to customer requirements [18].

While co-processing surely represents a great solution to dealing with the mass of end-of-life windmill blades for now, other options shall not be dismissed. Alternative technologies like mechanical recycling, solvolysis (that results in the formation of new compounds) and pyrolysis (thermal decompositions) are already being developed.

Since both glass fibres and carbon fibres are not only used for the production of windmill blades, but also as a reinforcing agent for many polymer products such as in insulation, aviation, the automobile industry and many more, there is a pressing global demand.

A study published in 2008 by the United States Geological Survey estimated the resources that would be required to fulfil the US commitment to supplying 20% of its electricity from wind power by 2030. They found that there will be a need for 110,000 and 115,000 metric tonnes of fibre glass per year, which represents a 14% increase [17].

It should therefore not only be of importance to treat the waste, but also to generate new ways of material recovery. In the long run, this will be the main concern.

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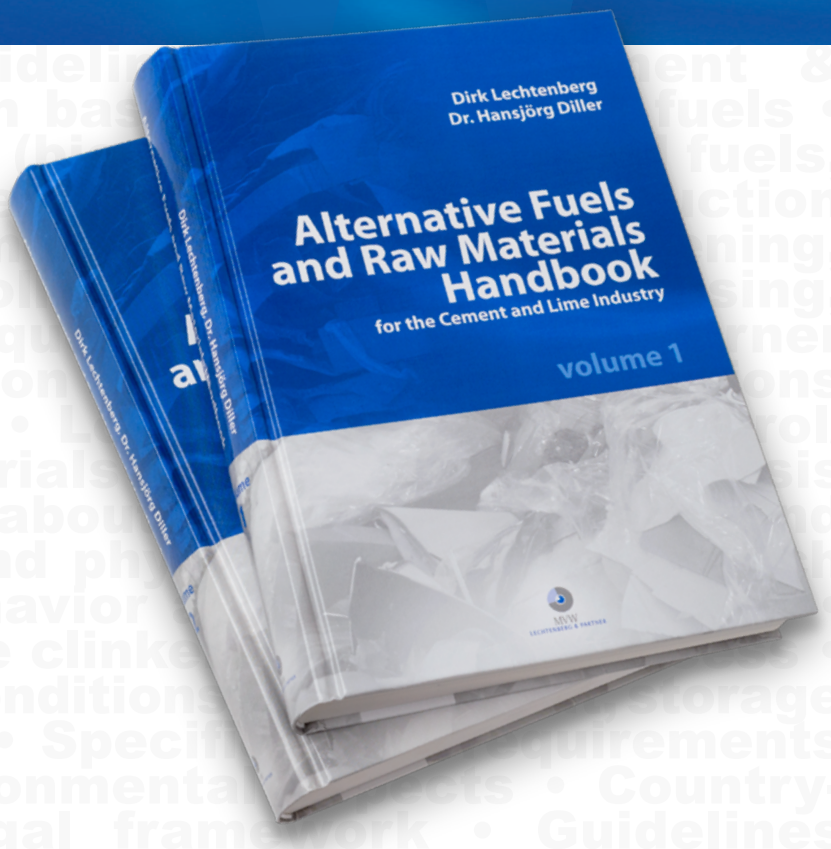

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Co-Processing Magazine of Alternative Fuels & Raw Materials

Improvement of Alternative Fuel Installations with prepol® SC Technology

By Stephan Pallmann, Head of Process & Quotation Pyroprocessing and Samuel Zühlsdorf, Product Manager prepol® SC I polysius® Fuel Substitution, thyssenkrupp Industrial Solutions AG, and Luis Montilla, Technical Director at Cementos Artigas S.A. / Cementos Avellaneda SA

With standard pre-calciners, the combustion of alternative fuels is demanding. The waste has to be pre-processed to be fine and light, otherwise it will not be suspended in the gas flow and fall down into the kiln inlet. On the other hand, it requires long pre-calciners to provide sufficient residence times to ensure a proper fuel burnout. Alternatively, alternative fuels can be treated thermally in combustion chambers, that can be attached to pre-calciners. These chambers provide additional retention time in a range of minutes and allow the utilization of even coarse and moist alternative fuels at higher substitution rates. This article gives an overview about the first installation of a prepol® SC- S at a riser duct kiln at Cementos Artigas in Minas, Uruguay.

State of the art of co-processing

Industrial and municipal solid wastes must be sorted and shredded for successful co-processing in the cement clinker burning process, as the gas residence time in the system is too short to burn the alternative fuel in its original particle size. For the combustion in the sintering zone, the waste has to be treated much deeper, so that only the two-dimensional particles (foils) remain in the product stream. This two-dimensional fraction has to be shredded down to 10-30 mm. As a consequence of 3 – 6 seconds of residence time in the

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pre-calciner, the preparation efforts are slightly lower. The particle size can vary between 20 and 80 mm in two dimensions and up to 5-10 mm in the third dimension.

A demand for a high substitution rate goes along with a high demand for the alternative fuel's quality. Depending on the available waste source, the efforts for treatment need to be adjusted most suitably. For the general setup of the complete waste-to-energy chain, the following parameters play a major role:

- Availability of waste sources
- Investment in the fuel preparation plant
- Operation costs for the fuel preparation plant (especially the shredding consumables)
- Electrical energy demand, especially for shredding
- Utilization rates of the resource waste: high disposal rate of organic rejects
- Quality demand resulting from the combustion process

In the recent past, a lot of alternative fuel installations started with the thermal utilization of tire chips. Although high efforts for the treatment are mandatory, the handling of the bulky material is comparably easy and the sourcing can usually be ensured for lower capacities. Nonetheless, with increasing capacities, the fraction of tire chips in the AF mixture decreases over time.

The philosophy behind combustion chamber systems

A combustion chamber replaces mechanical and biological preparation with thermal pre-treatment of a roughly prepared waste. It accepts fuels that have usually undergone just a single stage preparation. The roughly pre-treated high caloric fraction is so efficiently converted in the combustion chamber, that the remaining char can be carried by the gas stream and completely burns out in the calciner during the normal retention time. This process represents a significant simplification of the previously required mechanical preparation process of biomasses or refuse derived fuels and leads to a substantial cost reduction both in the investment as well as in the operational costs of a complete waste-to-energy chain.

The prepol® Step Combustor - a waste incineration grate for cement plants

This type of combustor consists of a step grate that is designed for a material retention time of approx. 15 minutes. Compared to a typical retention time of only 3-6 seconds in an ordinary pre- calciner, this residence-time is more than 150 times longer and allows the combustion of very coarse AF particles even if they have high moisture contents. Figure 1 shows the principle of the whole system.

The fuel is ignited without any kind of burners. The air, recuperated from the clinker cooler, is hot enough to bring the required ignition energy and the required oxygen. In order to control the temperature inside the system, raw meal is mixed to the tertiary air, so that the calcination starts already in the unit and absorbs the generated energy from the combustion. Via a quick reacting control loop, the share of meal in between the calciner and the prepol® SC is permanently adjusted.

The alternative fuel is evenly and steadily fed by two screw conveyors which push the AF onto the first longer step of the grate (figure 6). On this preliminary table, the incoming fuel piles up and acts as a seal against false air, prevents hot gas from flowing back into the screw conveyors and protects the feeding screws against overheating. The AF remains on this table for a few minutes while it is dried, pyrolyzed and ignited by contact with the tertiary air. Large shares of the volatile constituents are already released and burnt during this time.

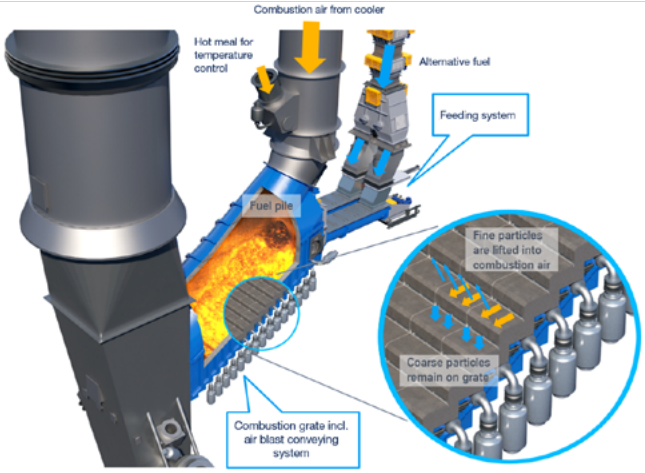

Figure 1: *Principle of the prepol® SC system*

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Afterwards, the fuel is pushed down to the first step of the grate. This second part of the grate is equipped with ordinary air canons (figure 8). With low pressures, the fuel is softly blown from step to step. When the fuel is lifted up, the complete material surface is getting into contact with the hot, oxygen rich air. All particles that are already burnt down enough to be flyable in the calciner are leaving the combustion chamber suspended in the tertiary air stream. Only the coarse particles remain on the grate until they are burnt down enough to be handled also in the calciner. Since only that kind of fuel is treated on the grate that really needs it, the combustion process is very defined and high throughput rates can be achieved.

Field of application

The prepol® SC has been designed to allow a flexible use of a wide variety of solid fuels. The capacity of the combustor is determined by the interaction of retention time and volume flow. The greater the density of the alternative solid fuel and the higher its calorific value, the higher is the attainable thermal performance.

Another flexibility the system offers is the modular adjustment of its size. In accordance with the existing installation and the boundary conditions of the project, the number of steps and segments can be defined individually. The left side of Figure 2 shows a complete unit of the prepol® SC, designed for highest retention times and dedicated to highest substitution rates even with alternative fuels of lowest qualities.

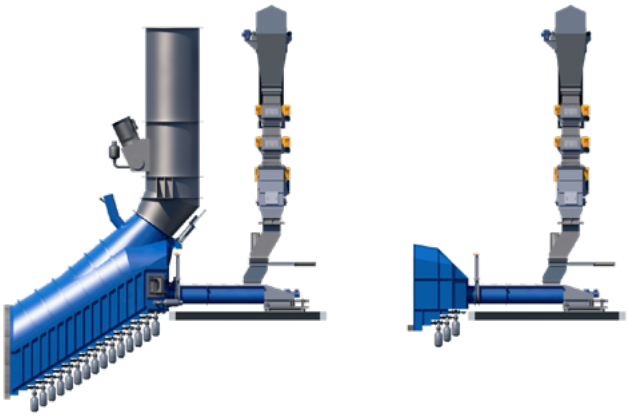

Figure 2: *From the prepol® SC to the prepol® SC–S, the modular concept ensures highest flexibility*

On the right side, the shortest possible version of the system is shown which is named prepol® SC-S. It is an implemented solution (Figure 3), taking advantage of the existing pre-calciner features like the tertiary air flow and the meal feeding. Some additional minutes (3 – 5) of retention time, enable the following AF scenarios at (existing) pre-calciner loops.

- High TSR rates for plants with no or short calciners (high quality AF)
- Non-flyable fuels with significant TSR (medium / low quality AF)
- Same fuel as prepol® SC, but at limited TSR (start-up solution where fuel is not available) (very low-quality AF)

The setup of the prepol® SC-S is reduced to the core components. It can be easily implemented in narrow, existing plants and to almost every preheater process setup (e.g., riser duct, SLC, etc.). The first installation of a prepol® SC-S was successfully commissioned in 2020 for Cementos Artigas in Minas, Uruguay.

Installation of the prepol ® SC-S in Minas cement plant of Cementos Artigas

CEMENTOS ARTIGAS S.A. has been in the market of the production and marketing of cement for the construction industry since 1919, being the pioneer and unique company in Uruguay until the middle of the twentieth century. Since its inception, the company participated in the active development of the modern infrastructure of the country, including emblematic works such as the Salvo Palace.

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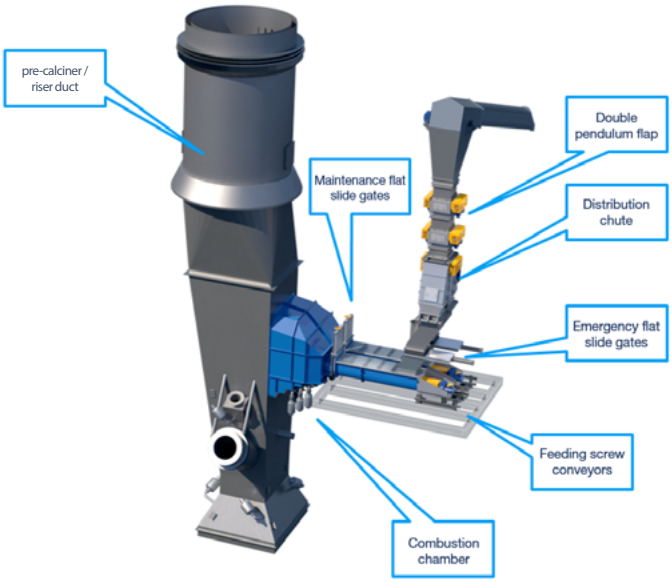

Figure 3: *Exemplary installation situation of a prepol® SC-S*

In 1997 a new 1,500 t/d clinker line was commissioned. The preheater has one line with five cyclone stages and an upstream riser duct without any tertiary air connection.

The many years of experience with alternative fuels at the Minas cement plant meant that even before the installation of the prepol® SC-S it was possible to operate the riser duct at the preheater as well as the main burner to certain heat shares with alternative fuels.

From the beginning, tire chips (< 80 mm x 80 mm x 10 mm) were directly fed into the upper part (Figure 4) of the riser duct. Therefore, a dosing unit which ensured the feed rate and the air tight sealing followed by a gravimetric feeding chute was used. The high gas velocity in the riser duct as well as the very short retention time led to the fact that unburned tire chips ended up in the lowest cyclone step. Process problems like an uncontrolled burn out and cyclone clogging occurred. Only low amounts could be fed.

These problems led to the approach to feed coarser tire chips (< 100 mm x 120 mm x 15 mm) directly into the kiln inlet (figure 9). Facing coating formations and CO generation in the kiln inlet as well as blockages in the dosing unit, stable feed rates around 0,9 t/h could be established on a long-term basis.

Figure 4: *Dosing unit and gravimetric feeding chutes at different elevations (riser duct / kiln inlet)*

For a further increase of the substitution rate, different scenarios have been investigated by Cementos Artigas. A solid business case with a suitable upgrade towards a pre-calciner with orifice and sufficient retention time could not be created without a clinker capacity increase. Further drawbacks were the stability of the existing concrete structures and the limited space inside the preheater tower. After comparing different combustion chamber systems and also one gasifier solution, the decision was finally taken in favour of the prepol® SC technology and thus for the first prepol® SC-S.

For the elaboration of the final concept, several boundary conditions had to be taken into consideration:

- existing process with riser duct and no tertiary air connection
- limited space inside the existing concrete structures of the preheater tower
- re-use of the existing feeding system as good as possible
- mainly large tire chips for the short-term feed, unknown mix of AF for the future

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Figure 5: *Preassembly on ground level and subsequent lift of the combustion chamber*

The extent of the project covered the supply and implementation of the prepol® SC-S, as well as the connection of the auxiliary equipment. Due to its comparably small size, the assembly works (Figure 5) during the annual plant shut down in 2019 took less than three weeks. Main points for the tie-in were at the riser duct and at the feeding chute below the dosing unit as well as at the control system.

Operation

Hot commissioning of the prepol® SC-S took place after the combustion chamber had been fully integrated into the plant in January 2020. The first tests with fuel feed were carried out using the same tire chips with the same mass flow as for the direct feed through the kiln inlet. Within less than 3 days, the original capacity could already be increased by 50%. After having solved minor start-up difficulties and the adjustment of the air blast conveying system, a stable feed without disturbing the kiln operation was established (figure 7). No fall through of tire residues into the kiln inlet was detectable, the CO values remained at the same level as before the modification. Without difficulties, the capacity of the prepol® SC-S was further increased towards the possible maximum: 100% thermal substitution rate in riser duct, which is equal to 24% of the total TSR.

By doubling the existing mass flow to a long-term average of 1,8 t/h within less than one week, the first prepol® SC-S could be successfully commissioned by Cementos Artigas and thyssenkrupp Industrial Solutions. The taking over certificate was signed two weeks after commissioning.

“With the prepol® SC -S inclusion, we achieve more than 24% TSR with 80mm tire chips in a kiln without calciner”, says Leandro Pedetti, plant manager at Cementos Artigas Minas.

Outlook

The increase in combustion capacities lead to a faster emptying of the overall tire chips stock. Since there is a lack of capacities in the permanent supply chain, Cementos Artigas intensified their exploration of new waste sources. A primary shredding step has been setup to prepare biomasses as well as commercial and industrial wastes for the thermal utilization

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via the prepol® SC-S. All the tested industrial wastes were efficiently burned, both alone or mixed with tire chips.

With the first prepol® SC-S, another milestone was set. The combustion chamber technology is more and more establishing in the cement industry, - based on the same core technology as the prepol® SC-S for Cementos Artigas, several other prepol® Step Combustor are on their way to be commissioned soon.

Among them is for example the biggest alternative fuel installation in the world or a solution to utilize efficiently medium quality alternative fuels at a Separate Line Calciner.

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Figure 6: *prepol® SC-S feeding screw conveyor with maintenance slide gate*

Figure 8: *Patended air blast conveying system*

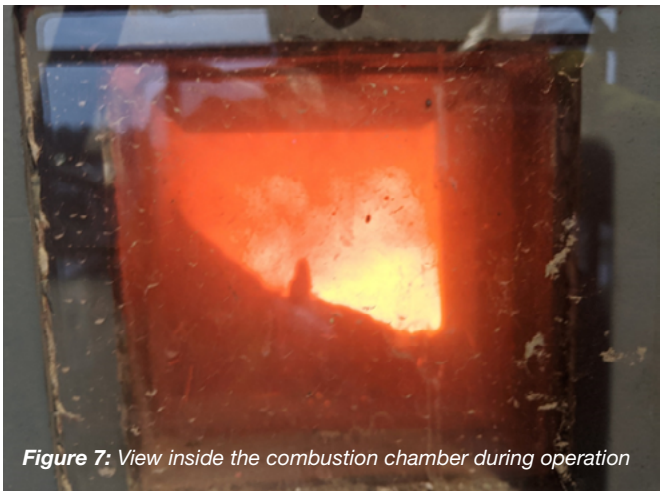

Figure 7: *View inside the combustion chamber during operation*

Figure 9: *Direct feeding of tire chips before the installation of the prepol® SC-S*

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- Svante Inc. Secures 75 Million USD Funding for Carbon Capture ProjectsRichmond Cement Facility

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- Melón and Enel Generación Sign Renewable Energy Contract

Cyprus

- Lindner Shredder for RDF Production in Cyprus

Germany

- Carbon Capture Technology to be Scaled up: LEILAC 2 Installation to be Built at HeidelbergCement Plant in Hanover
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- Cemex Awarded Grant From U.S. Department of Energy to Develop Pioneering Carbon Capture Technology
- Veolia and GE Renewable Energy Recycle Wind Turbine Blades for Cement Industry Applications

Canada

CO2MENT Phase II Complete at Lafarge Richmond Cement Facility

Lafarge Canada Inc., Svante Inc., and Total S.A., have reached a major milestone of their CO2MENT project, a first of its kind partnership to capture industrial levels of CO_2 emissions from a cement plant. The multi-phase project celebrates the completion of Phase II of the construction for the technology to capture and filter CO_2 from flue gas. This is a crucial component to achieve the next stage of capturing CO_2 flow at the Lafarge Richmond Cement facility in British Columbia.

The Svante capture unit, a carbon capture technology designed to trap CO_2 produced from industrial processes, is now installed at the Richmond Cement Plant. The completion of this phase allows the cement facility to capture the CO_2 contained in its cement flue gas and to reuse it for CO_2-cured concrete, thus storing it permanently. Coupling this equipment with the alternative fuels used at the plant creates the world's first full-cycle solution to capture and reuse CO_2 from a cement plant. The carbon-efficient examples achieved here are leading the way to a near-zero emissions cement facility.

Phase III, scheduled for work over the next 3 years, will include the installation of a liquefaction unit and the development of an expansion project to further reduce emissions, as well as a business case review for further expansion across the Lafarge network.

Source: WorldCement : "CO2MENT Phase II complete at Lafarge Richmond Cement Facility", retrieved 22 January from https://www.worldcement.com/the-americas/22012021/co2ment-phase-ii-complete-at-lafarge-richmond-cement-facility/

Svante Inc. Secures 75 Million USD Funding for Carbon Capture ProjectsRichmond Cement Facility

Svante Inc. has announced that it has successfully closed the Series D equity financing, the largest private investment into point source carbon capture globally to date.

The financing was led by Temasek and includes strategic investors Chart Industries, Carbon Direct and Export Development Canada (EDC). Existing investors OGCI Climate Investments, BDC Cleantech Practice, Chevron Technology Ventures, The Roda Group and Chrysalix Venture Capital also participated in the round, reflecting strong on-going support for the company, including its market strategy and recent progress.

This new financing provides Svante with growth capital to advance a number of initiatives over the next three years, including work to support several commercial scale carbon capture facilities to address hard-to-abate emissions from industrial operations such as cement manufacturing.

"Lowering the capital cost of the capture of the CO_2 emitted in industrial production is critical to the world's net-zero carbon goals required to stabilise the climate," said Claude Letourneau, president and CEO of Svante Inc.

Source: CemNet: "Svante Inc secures US$75m funding for carbon capture projects", retrieved 3 February from https://www.cemnet.com/News/story/170249/svante-inc-secures-us-75m-funding-for-carbon-capture-projects.html

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Chile

Melón and Enel Generación Sign Renewable Energy Contract

Chile-based Cementos Melón has signed a contract with Enel Generación for the supply and renewable energy in four of Melón's operations: The La Calera, Ventanas and Puerto Montt cement plants and the San Bernardo aggregates facility.

The agreement will run until 2043 and includes the supply of renewable energy from wind, solar, geothermal or hydropower with the option to expand this to more Melón sites in the future, reports Electricidad.

'We have state-of-the-art technologies, we work together with our carriers in programs to reduce logistical and energy efficiency, and we have a solid co-processing strategy for the use of alternative fuels and raw materials", said Cementos Melón General Manager, Iván Marinado.

Source: CemNet: "Melón and Enel Generación sign renewable energy contract", retrieved 24 February from https://www.cemnet.com/News/story/170363/mel-n-and-enel-generaci-n-sign-renewable-energy-contract.html

Cyprus

Lindner Shredder for RDF Production in Cyprus

Austria-based Lindner-Recyclingtech GmbH says one of its Polaris 2800 model shredders is helping convert scrap tires, wood and other discarded materials into a refuse derived fuel (RDF) product for a cement kiln in Cyprus.

Vassiliko Cement Works is among the biggest industrial players in the island state and operates one of the largest and most advanced cement plants in Europe near Mari, between Limassol and Larnaca. To ensure the amount of energy needed to produce approximately 6,000 metric tonnes of clinker per day, the company relies on resource-saving alternative fuels from its associated company Enerco.

The new shredder, installed with associated Lindner system components, produces fuel onsite with a particle size of approximately 50 millimetres.

Source: Recyling Today: "Lindner shredder churns out RDF in Cyprus", retrieved 4 February from https://www.recyclingtoday.com/article/lindner-shredder-polaris-cyprus-rdf-wood-tire-recycling-waste-energy/

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Germany

Carbon Capture Technology to be Scaled up: LEILAC 2 Installation to be Built at HeidelbergCement Plant in Hanover

After very good results from the first project phase, HeidelbergCement is starting the further development and scaling-up of the LEILAC technology (Low Emissions Intensity Lime And Cement) together with the Australian technology company Calix and a European consortium. After examining different locations, it has been decided to build the LEILAC 2 demonstration installation for carbon capture at the HeidelbergCement cement plant in Hanover, Germany.

As part of LEILAC 1, a CO_2 capture pilot installation with a capture capacity of 25,000 tonnes of CO_2 per year was constructed at HeidelbergCement's Lixhe plant in Belgium in 2017. With LEILAC 2, an installation around four times as large will be operated in Hanover, which will capture 20% of the cement plant's capacity, corresponding to around 100,000 tonnes of CO_2 per year. The first project design phase is to be completed by the end of June 2021, and the demonstration installation is expected to be ready by the end of 2023. Including design, construction, commissioning and extensive testing, the overall project is expected to be completed by 2025.

The project costs amount to €25 million, of with €16 million are coming from the EU research funding programme Horizon 2020 and €9 million are being provided by the partners of the project consortium. HeidelbergCement's share amounts to €3 million. The project in Hanover will also include preliminary investigations into the use of the captured CO_2.

Source: HeidelbergCement: "Next industrial scale-up of a CO_2 capture technology: LEILAC 2 pilot project will be lovated at HeidelbergCement's Hanover cement plant", retrieved 1 February 2021 from https://www.heidelbergcement.com/en/pr-01-02-2021

Cemex Creates "Carbon Neutral Alliance" in Germany

CEMEX, S.A.B. de C.V. ("CEMEX") (NYSE: CX) announced today that, as part of its "Future in Action" program, it is developing a carbon neutral alliance in Germany to test and accelerate innovative technologies to reach carbon neutrality at its Rüdersdorf plant.

CEMEX is joining pioneering industrial consortiums with the objective of developing industrial-scale demonstration projects utilizing ground-breaking technologies to form this alliance, which aspires to achieve carbon neutrality at the Rüdersdorf plant by 2030. Several technologies, including waste heat recovery, carbon capture and transformation into building materials, synthetic fuels, and green hydrocarbons, are being evaluated, including hydrogen production with renewable energy.

"It is expected that CO_2 will be further processed to convert to new forms of energy and materials for use locally by industrial, residential, and transport sectors. Together with our partners, we will take feasibility studies through to economic solutions to decarbonizing cement production," said Stefan Schmorleiz, plant manager and managing director of CEMEX Zement GmbH.

Source: Cemex: "CEMEX creates "Carbon Neutral Alliance" in Germany", retrieved March 17 from https://www.cemex.com/-/cemex-creates-carbon-neutral-alliance-in-germany

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Germany

Thyssenkrupp Develops Technology for Cement Industry Carbon Capture

The Oxyfuel technology replaces ambient air in the clinker production process with pure oxygen introduced into the front zone of the cooler. As the nitrogen content of the air is no longer present, the CO_2 concentration in the kiln exhaust gas can be increased to up to 100%. This much more efficient CO_2 separation serves as the basis for the downstream utilisation or storage of carbon dioxide.

However, the advantage of reducing the exhaust gas to a virtually pure CO_2 stream means that there is too little gas in the preheater to operate the cyclones. In the first-generation Oxyfuel process, this necessitated a complex gas recirculation system from the preheater exhaust to the cooler involving heat exchange, dust removal, and condensation.

Dr. Georg Locher, Head of R&D: "With the second-generation polysius® pure oxyfuel process, exhaust gas recirculation can be eliminated, resulting in considerable savings in investment and operating costs, and making polysius® pure oxyfuel the best-in-class technology for CO_2 capture. Another advantage is that existing kiln plants can also be retrofitted with this process. By using the polysius® pure oxyfuel process, our customers profit from optimised operating costs, while freeing our communities and environment from high CO_2 emissions."

The four European cement manufacturers Buzzi Unicem-Dyckerhoff, HeidelbergCement AG, SCHWENK Zement KG, and Vicat plan to investigate the industrial-scale use of Oxyfuel carbon capture technology in cement production in a demonstration plant. To this end, the research company "CI4C - Cement Innovation for Climate" was established. The aim is to capture 100% of the CO_2 and use it with the help of renewable energies to produce so-called 'refuels', i.e., climate-neutral synthetic fuels such as kerosene for the aviation industry.

Source: WorldCement: "thyssenkrupp develops technology for cement industry cabon capture", retrieved 10 March from https://www.worldcement.com/europe-cis/10032021/thyssenkrupp-develops-technology-for-cement-industry-carbon-capture/

Vecoplan AG Joins RETech Partnership

Vecoplan AG is now a member of the German RETech Partnership, a network of German companies and institutions from the recycling and waste management industry. The network works closely with national and international ministries, authorities, institutes and business associations. Among other advantages, Vecoplan will receive support in exporting its recycling and waste management technologies and in knowledge transfer.

"As a member we'll always be up to date on matters like country data, current invitations to tender and funding and financing options," says Tim Hamer, head of Sales for Waste and Alternative Fuels at Vecoplan AG. "The network will enable us to establish important contacts, and it will provide support in organising events and conferences at the national and international levels."

With the help of this strong network, it will be possible to develop custom solutions for comprehensive waste management concepts while addressing country-specific conditions, claimed Vecoplan.

Source: Vecoplan: "Part of a strong community", retrieved 11 March from https://vecoplan.com/fileadmin/pdf/Pressemitteilung/news-03-2021-retech-en.pdf

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India

Ambuja Cement and Geocycle to Handle T 20 Cricket Match Series Wastes

As official partners of Board of Control for Cricket in India (BCCI), Ambuja Cement supported by Geocycle, the waste management solutions unit of LafargeHolcim, will carry out this clean-up initiative from 12 to 20 March 2021 after the matches.

The 5-match series at the world's largest cricket stadium will create 3-4 tonnes of waste and approximately 1 tonne of single use plastic. Enabling a circular economy model, the collected waste will be re-purposed and safely managed through co-processing in the cement kiln at Ambujanagar plant in Gujarat. This technology is recognized globally and is one of the safest methods of waste management.

Source: Ambuja Cement: "Ambuja Cement joing hands with BCCI on Swachh Bharat Abhiyan", retrieved 16 March from https://www.ambujacement.com/Upload/PDF/Ambuja%20Cement%20joins%20hands%20with%20BCCI%20on%20Swachh%20Bharat%20Abhiyan-Press%20Re.pdf

Indonesia

All of SIG's Cement Plants Now Operate on Alternative Fuels

PT Semen Indonesia has set the goal of getting all of its cement plants to operate on alternative fuels. This effort will also support the government's aim of reducing Indonesia's use of coal.

"We want to provide a long-term solution in overcoming the problem of domestic waste that can have a positive impact on the environment and society at large," said SMGR Director, Hendi Prio Santoso, in a press statement.

He explained that all factories now without exception have used biomass as an alternative fuel. At Solusi Bangun Andalas factory (Aceh), Semen Padang (West Sumatra) and Semen Tonasa (South Sulawesi), for example, the alternative fuels used come from rice husks and sawdust. Additionally, since 2008, all operations at the Tuban factory, East Java, have also used biomass fuel from rice husks, coconut husks, tobacco waste and corn kernels.

"We get all agricultural waste from a number of districts in East Java, including Tuban, Lamongan, Bojonegoro and Banyuwangi. This year, every month the Tuban Factory receives 2553 tonnes of rice husk, 244 tonnes of coco peat, 244 tonnes of tobacco waste and 90 tonnes of reject paper, all for our alternative fuel sources, " said Mr Santoso.

As for the factory owned by PT Solusi Bangun Indonesia Tbk (SBI), which is one of SIG's subsidiaries, the company has used municipal solid waste (MSW) as an alternative fuel in making cement through the integrated refused derived waste management facility (TPS RDF) in the Tritih Lor, Jeruklegi, Cilacap Regency. This facility was inaugurated in July 2020 and is the first integrated domestic waste processing facility in Indonesia.

Source: CemNet: "All of SIG's cement plants now operate on alternative fuels", retrieved 9 February from https://www.cemnet.com/News/story/170278/all-of-sig-s-cement-plants-now-operate-on-alternative-fuels.html

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Italy

Cementir Holding to Increase Alternative Fuels Use

As part of its sustainability commitments, Italian cement group Cementir Holding has set a CO_2 emissions reduction target of around 30% by 2030, with emissions below 500kg/t of grey cement. However, it said that under the future European Taxonomy criteria white cement emissions are not included.

The group is planning to invest around €107 million from 2021 to 2023 in sustainability and digitalisation. This includes the construction of a new calcination plant in Denmark for the production of its Futurecem product, and the installation of wind turbines with an installed capacity of 8.4MW. It is also planning to increase the alternative fuels substitution rate at its integrated Gaurain plant in Belgium from 40 % to 80 % and to invest in the use of natural gas and biogas in some of its plants.

Source: Markets Insider: "Cementir Holding increases sales and cement and clinker volumes in 2020", retrieved 5 February 2020 from https://markets.businessinsider.com/news/stocks/cementir-holding-increases-sales-and-cement-and-clinker-volumes-in-2020-9779141

Mexico

Cemex's European Cement Plants Deploy 'Groundbreaking' Hydrogen Technology

Hydrogen technology has been successfully introduced in all of Cemex's European cement plants, the cement producer announced end of February.

With an estimated 40 million USD investment programme, Cemex said it is moving quickly to extend this technology to the rest of its operations around the world, including Mexico, the US, South and Central America, and the Caribbean, Africa and Asia.

Cemex executed initial trials of this innovative technology at its Alicante, Spain cement plant in July 2019 and quickly confirmed its potential as a lever to significantly reduce CO_2 emissions.

The technology was installed in 2020 in all cement plants in Europe. In 2021, Cemex said it will roll this out to substantially all its global operations.

With this new technology, hydrogen enhances the cement kiln's combustion process, adding another relevant tool in the company's 2030 roadmap to reduce CO_2 emissions in the short term.

Source: Cemex: "Cemex successfully develops hydrogen-based ground-breaking technology", retrieved 22 February from https://www.cemex.com/-/cemex-successfully-deploys-hydrogen-based-ground-breaking-technology

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Mexico

CEMEX Recognized by S&P in 2021 Yearbook for Sustainability Excellence

CEMEX has announced that it has been included in the 2021 S&P Global Sustainability Yearbook for the second time (previously in 2017 yearbook). This yearbook is considered the world's most comprehensive publication on corporate sustainability – based on information collected through the S&P Global Corporate Sustainability Assessment.

In order to be listed in the yearbook, companies must score within the top 15% of their industry and must achieve an S&P Global ESG Score within 30% of their industry's top-performing company.

"We are honoured to be included in the S&P Global Sustainability Yearbook 2021, proving our leadership in sustainability" said Vicente Saisó, CEMEX Global Head of Sustainability. "This recognition reaffirms our commitment to build a better future for all of our stakeholders and underscores the key role that sustainability plays in our business strategy."

This year, CEMEX obtained Industry Best Score in latest CSA for several categories including Climate Strategy and Environmental Reporting.

Source: CEMEX: "CEMEX is recognized by S&P in 2021 Yearbook for sustainability excellence", retrieved 10 February from https://www.cemex.com/-/cemex-is-recognized-by-s-p-in-2021-yearbook-for-sustainability-excellence

Nigeria

Lafarge Africa Commits 5.5 Million USD to Environmental Sustainability

Lafarge Africa Plc, the Nigerian operations of Lafarge-Holcim, recently committed a total of 5.3 million CHF (around 5.5 million USD) to change its current Electrostatic Precipitator (ESP) to baghouse in its Ewekoro plant. This entails making significant adjustments including the shutting down of its kilns for at least 6 months to make this improvement.

Lafarge is also increasingly using biomass, including oil palm and rice husks, as alternative fuels to power its plants. Currently, a good number of cement plants in Nigeria are powered by coal, gas or low pour fuel oil. However, alternative fuels are considered cleaner, more sustainable, and also help surrounding communities dispose of waste more efficiently. Considering this, alternative fuels currently account for up to 40% of fuel used to power Lafarge Africa's Ewekoro plant. The company plans to have all plants operating on at least 35% alternative fuels by 2023.

Source: Business Day: "Lafarge earmarks $8million to environmental sustainability", retrieved 4 March from https://businessday.ng/companies/article/lafarge-earmarks-8million-to-environmental-sustainability/

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Philippines

Holcim Philippines to Improve Alternative Fuel Processing Facility

Holcim Philippines, Inc. has invested P121.5 million until 2022 to improve the alternative fuel processing facility at its cement plant in Norzagaray, Bulacan.

In a regulatory filing on January 14th, the company said the amount aims to improve the efficiency of its shredding operations that turn qualified waste materials to alternative fuels, establish new equipment, and upgrade storage and feeding facilities in its cement plant.

Holcim Philippines said the improvements will let its waste management unit support the company's Bulacan plant in using more post-consumer and municipal solid wastes as alternative fuels, rather than coal.

According to the company, it has been using qualified wastes such as non-recyclable plastics and biomass as alternative fuels in cement manufacturing since 2003, which is converted via co-processing.

In 2020, Holcim said it had co-processed around 130,000 tonnes of qualified wastes from local governments, industry partners, and agricultural processors in its plants in Luzon and Mindanao.

Source: Holcim: "Holcim Philippines invests on alternative fuel processing facility to strengthen position in waste management, low carbon fuel", retrieved 14 January from https://www.holcim.ph/holcim-philippines-invests-new-alternative-fuel-processing-facility-strengthen-position-waste

Republic Cement Partners With Colgate-Palmolive to Reduce Plastic Waste

Republic Cement and Building Materials, Inc. has inked an agreement with hygiene product maker Colgate-Palmolive Philippines, Inc. to reduce the amount of plastic waste which ends up in landfills and waterways.

"We are excited to be a part of their journey and we are confident that through our shared commitment towards sustainability, we will be able to help support Colgate achieve their goals in the Philippines," Republic Cement President and Chief Executive Officer Nabil Francis said in a press release on 17 March 2021.

Under the memorandum of agreement, which was signed on 18 December 2020, both firms have committed to using Republic Cement's resource recovery arm ecoloop to co-process plastic waste from Colgate-Palmolive.

In December, Republic Cement said its ecoloop was planning to co-process a minimum of 10 million plastic sachets or bags per day by 2021 in a bid to alleviate the country's waste problem.

Source: BusinessWorld Online: "Republic Cement partners with Colgate-Palmolive to reduce plastic waste", retrieved 18 March from https://www.bworldonline.com/republic-cement-partners-with-colgate-palmolive-to-reduce-plastic-waste/

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Poland

Poland's First Solar PPA Will See Photovoltaics Power Cement Production

The local subsidiary of German company HeidelbergCement will take solar electricity from the 65 MWp Witnica solar park between Pozna and Berlin for ten years under the power purchase agreement.

The first solar power purchase agreement (PPA) in Poland is a sign of the competitiveness of renewable energy even in a nation still heavily dependent on coal, according to Benedikt Ortmann, of German developer Baywa re.

"Here is the ultimate proof that photovoltaic power can – without any subsidies – be competitive to conventional energies, even in a European country further north which still generates 80% of its electricity from coal," said global director of solar projects Ortmann, in a press release issued by the Bavarian clean energy developer this morning to announce the PPA.

Under the terms of the contract, Baywa will supply solar electricity from its planned Witnica plant, near the German border, for a decade to the Górażdże Cement subsidiary of German company HeidelbergCement.

The 64.6 MWp Witnica solar park is set to come online between Poznan and Berlin by July when, Baywa said, it would be the largest in Poland.

Source: PV Magazine: "Poland's first solar PPA will see photovoltaics power cement production", retrieved 28 January from https://www.pv-magazine.com/2021/01/28/polands-first-solar-ppa-will-see-photovoltaics-power-cement-production/

Saudi Arabia

City Cement to Incorporate Waste and Recycling Subsidiary

The board of Saudi's City Cement Company has agreed to incorporate a new waste, environmental and recycling subsidiary LLC with registered offices in Riyadh.

The company announced in a statement to the Saudi Stock Exchange (Tadawul) today that its board of directors had approved the LLC company, which will fully be owned by City Cement and incorporated with SAR 500,000 (USD 133,000) capital.

"This trend comes in line with the company's strategy, and any developments in this regard will be announced in due course," the statement said.

Source: ZAWYA : « Saudi's City Cement to incorporate waste and recycling subsidiary", retrieved 18 March from https://www.zawya.com/mena/en/business/story/Saudis_City_Cement_to_incorporate_waste_and_recycling_subsidiary-ZAWYA20210311101938?utm_source=linkedin&utm_medium=linkedin&utm_campaign=site_share

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Spain

Cementos Molins Records Low Emissions at High Waste Recovery

In 2020, the emissions from furnace 6 in the company's Sant Vicenç dels Horts factory have remained well below the limits established for all registered chemical compounds, to the point that 6 of the 7 measured have not even reached 15% of the maximum permitted levels.

The energy recovery of waste is one of the main lines of improvement on which CMI has focused in recent years. In 2020, 44% of the thermal energy consumed in the Portland kiln have been obtained through the use of alternative fuels. This has led to the saving of 53,000 tonnes of petroleum coke, an amount equivalent to the annual energy consumption of 76,000 homes. The 84,309 tonnes of waste used have also not been landfilled and thus avoided the consequent pollution problems. This also has an impact on the reduction of CO_2 emissions, as the residues that come from biomass, considered carbon-neutral fuels, have allowed the saving of about 107,000 tonnes of CO_2, a figure similar to that emitted by 91,000 cars in one year.

In addition, in 2020, 18.5% of the electrical energy consumed by the factory came from renewable sources, thanks to the formalisation of a PPA contract for the supply of electricity from this source. This equals the reduction of almost 5,000 tonnes of indirect CO_2 emissions.

Source: World Cement: "Cementos Molins factory reduces emissions through recovery of waste and renewable energy", retrieved 22 February from https://www.worldcement.com/africa-middle-east/22022021/cementos-molins-factory-reduces-emissions-through-recovery-of-waste-and-renewable-energy/

United Kingdom

World Cement Association Committees Set 2021 Agenda

The World Cement Association's Professional Committees (Safety & Health, Environment & Climate Change and Technology & Innovation) announced their goals for the global cement industry in the new year at the WCA's 4th General Assembly Meeting in December, taking the opportunity to review progress made so far and set priorities for the year ahead.

Climate change, decarbonisation and sustainability challenges facing the cement industry led the agenda for the Environment & Climate Change Committee. The Committee's Chair, Ashwani Pahuja (Dalmia Cement), outlined the key focus for 2021, which will be on accelerating sustainability through addressing energy efficiency, alternative fuels, digitisation, CCUS, and promoting low carbon cement and concrete. The committee also intends to seek commitments from progressive companies towards zero/low carbon cement production.

Wang Kedong (CUCC), Chair of the Technology & Innovation Committee, presented a technology roadmap covering several key priorities, including reducing emissions and energy consumption, green product innovation, 'Industry 4.0' and digitalisation.

"This has been a very challenging and unpredictable year for our industry, and we have all had to adapt and find new ways of working. In this context, I'm especially pleased with how our Professional Committees have continued to work together effectively to tackle some of the sector's key issues." said Ian Riley, WCA CEO.

Source: World Cemet Association: "World Cement Association Committees Set 2021 Agenda", retrieved 18 January from https://www.worldcementassociation.org/blog/member-news/world-cement-association-committees-set-2021-agenda

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United Kingdom

Cemex Invests 25 Million USD to Phase Out Fossil Fuels at Rugby Cement Plant in the UK

CEMEX is investing 18 million GBP (25 million USD) in a new system to replace fossil fuels at its Rugby cement plant in the United Kingdom, as part of its "Future in Action" programme to achieve carbon neutrality.

The new system, which incorporates the use of green hydrogen in the production process, is expected to be fully operational in June 2021. Once completed, it will have the capability to operate at 100% with alternative fuels.

This important investment is designed to reduce the site's consumption of fossil fuels. CEMEX is one of the largest contributors to the circular economy and a leader in using alternative fuels with over 60% use across its European operations, significantly higher than the industry average. In the UK, CEMEX also obtains 100% of its electricity from renewable sources.

The project, which is part of a 100 million USD investment programme in the UK that has contributed towards reducing carbon dioxide emissions from European operations by 35% from 1990 levels, ten years ahead of its global business target, is instrumental towards reaching its commitment of at least 55% CO_2 reduction in European operations by 2030, in line with the European Commission´s aspiration for all its member states.

"We believe that this very significant investment in this upgraded facility supports CEMEX's position to minimise the use of fossil fuels for both environmental and economic reasons," said Sergio Menendez, President of CEMEX Europe, Middle East, Africa & Asia.

"It will enable the Rugby plant to consistently operate with up to 100% alternative fuels, which will contribute to our climate action targets."

Source: Cemex: "CEMEX invests US$25 million to phase out fossil fuels at Rugby cement plant in the UK", retrieved 9 March from https://www.buildersmerchantsnews.co.uk/CEMEX-invests-18-million-to-phase-out-fossil-fuels-at-Rugby-Cement-plant/50783

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USA

Blue Planet Becomes Associate Corporate Member of WCA

The World Cement Association (WCA) has further expanded its international network of members by welcoming Blue Planet as an associate corporate member.

Blue Planet is a Silicon Valley-based company which has developed a novel and cost-effective carbon-capture and utilization system that permanently removes carbon dioxide from the air.

Its technology uses CO_2 as a raw material to manufacture carbonate rocks that can be used in place of quarried natural limestone. CO_2 from flue gas is converted to carbonate by bringing CO_2-containing gas into contact with a water-based capture solution.

The process is said to differentiate Blue Planet from most carbon-capture methods as the captured CO_2 does not require a purification step, which is an energy and capital-intensive process.

'By bringing the latest technologies and best practice to the attention of our industry members, we increase the chance of evolving a sustainable cement ecosystem. I am, therefore, especially pleased to welcome Blue Planet, and look forward to their input on improving industry standards worldwide', said Ian Riley, chief executive officer of the WCA.

Blue Planet have been involved in several major projects, including at San Francisco International Airport, where their limestone-coated lightweight aggregate was used in concrete mixes.

'Blue Planet were launched specifically to mitigate global CO_2 emissions by transforming them into synthetic limestone aggregate for use in concrete, so our mission is very closely aligned with the WCA's efforts in the climate change arena,' said Brent Constantz, founder and chief executive officer of Blue Planet.

Source: AggNet: "Blue Planet join World Cement Association", retrieved 22 March from https://www.agg-net.com/news/blue-planet-join-world-cement-association

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USA

Cemex Awarded Grant From U.S. Department of Energy to Develop Pioneering Carbon Capture Technology

CEMEX announced on 8 February that its U.S. operations have been awarded a grant from the United States Department of Energy to research, engineer and develop a pilot for a breakthrough carbon capture unit. The project, anchored to CEMEX's Victorville, California cement plant, will also contemplate cost-competitive solutions to completely close the loop on current carbon emissions.

In this initiative led by RTI international (RTI), a non-profit research institute, CEMEX is joining forces with UK-based Carbon Clean and Oak Ridge National Laboratory. The goal of the consortium is to increase efficiencies and value in CEMEX's overall building material fabrication process, while significantly reducing its CO_2 footprint through the leverage of technological upgrades. The specific objectives of this project also include the development, optimization and scaleup of specific CO_2 capture process components, as well as incorporation of next-generation non-aqueous solvents. Integration aspects of the low-cost, modular, process intensification capture technology with CEMEX's cement plant are also planned to be covered, together with subsequent cost evaluations and technical considerations for the transformation of captured CO_2 into new marketable products.

Source: Cemex Ventures: "CEMEX awarded grant from U.S. Department of Energy to develop pioneering carbon capture technology", retrieved 8 February from https://www.cemexventures.com/cemex-awarded-grant-carbon-capture-technology/

Veolia and GE Renewable Energy Recycle Wind Turbine Blades for Cement Industry Applications

Veolia North America and GE Renewable Energy have started recycling wind turbine blades for use in cement manufacturing. GE Renewable Energy has signed a multi-year agreement to provide Veolia with old blades as they are replaced to upgrade turbine systems.

"The traditional path would be to recycle them into new blades, but we started looking at alternatives when we couldn't do that, and we came up with the idea to use the chemical components of the blades. Most of their chemical composition could be used to make cement, with the two main materials being silica and calcium," explains Bob Cappadona, COO for Veolia North America's Environmental Solutions and Services division.

The silica and calcium become a part of the cement raw ingredients during the processing/manufacturing of cement. About 65% of the blade is going into the cement and about 28% will be used as energy for the cement industry.

According to Veolia and GE Renewable Energy, recycling one 7 tonne wind turbine blade enables a cement kiln to avoid the potential consumption of nearly 5 tonnes of coal, 2.7 tonnes of silica, 1.9 tonnes of limestone, and almost a tonne of other raw materials.

Source: Waste 360: "Veolia and GE Renewable Energy Recycle Wind Turbine Blades for Cement Industry Applications", retrieved 17 February from https://www.waste360.com/energy/veolia-and-ge-renewable-energy-recycle-wind-turbine-blades-cement-industry-applications

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