Co-Processing Magazine
of Alternative Fuels & Raw Materials

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2021

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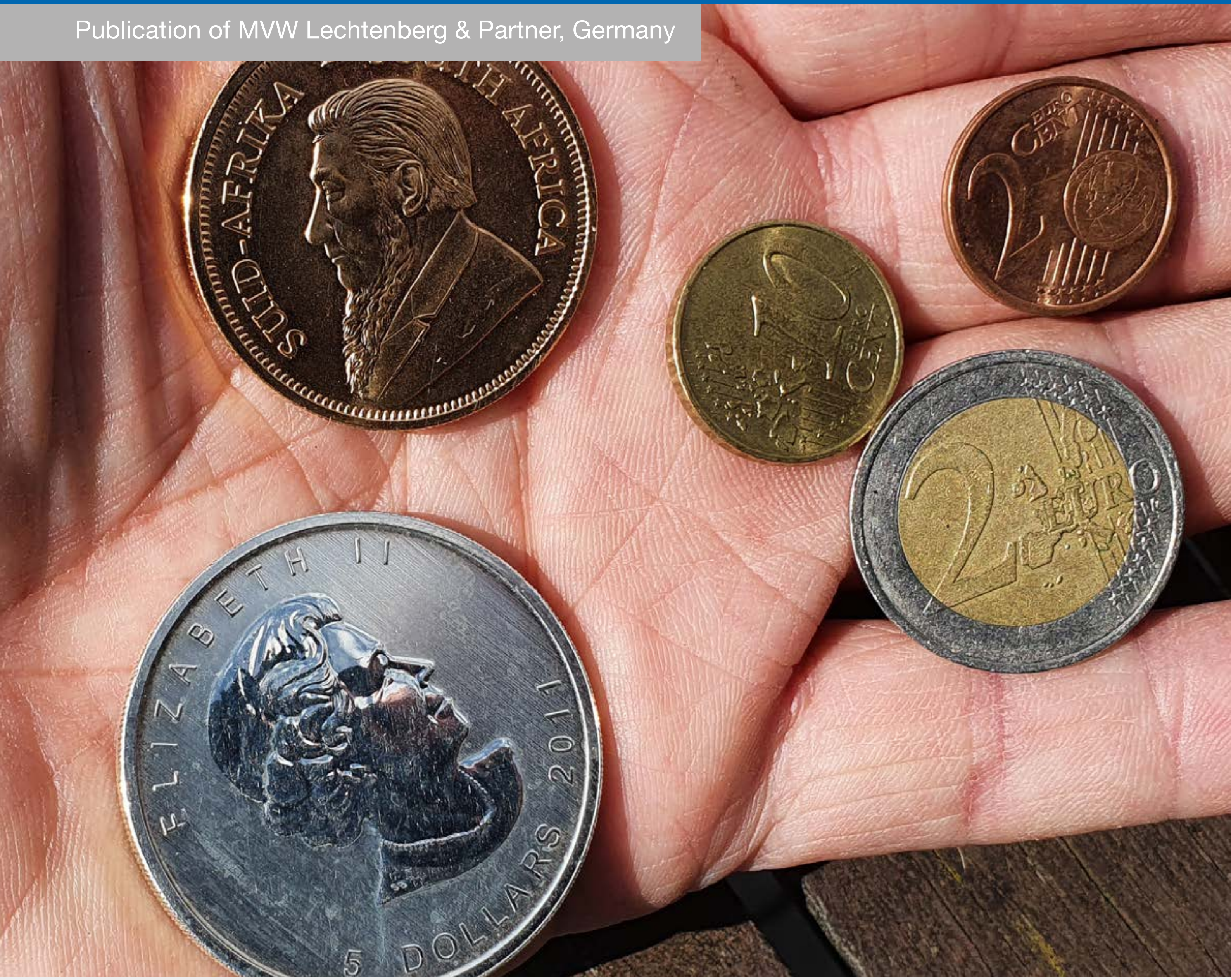

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Contents

Everyone is either talking about climate change, deadly weather shocks all around the world, half of Europe was on fire and then came flash flood here in Germany caused many deaths, either weather was (too cold, too hot, too dry, or too much rain), the Afghanistan war (which is as nonsensical as any other war), the 4th wave or the next COVID-19 mutation. Popular topics are also (once again) cancelled holidays. Out of the 30 news stories, you will not find any single news to be positive.

Therefore, I would like to start this issue with something positive.

1. Cancer can be treated better than before: Over the last 20 years, theww death rate from cancer has decreased by 20%, and the number is still decreasing.

2. Global poverty is at a record low.

3. Infant mortality is the lowest in human history.

4. The ozone layer is slowly repairing itself. The reason for this is that certain chemicals such as chlorofluorocarbons (CFCs) in aerosol cans or fridges have been banned from use since the 1980s.

5. After the first ban 20 years ago, leaded gasoline is no longer available anywhere in the world.

I could (almost) continue this list endlessly. But maybe you should take a look at our environment and see what has changed for the better in recent years. Countries are already signing up to deep carbon cut emissions. Since then, Japan and South Korea have joined a group of over 110 countries that have set a net zero aim for the

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Dear Readers,

mid-century period, according to the UN. There is a solid reason why so many countries are now declaring their intention to become net zero: the dropping cost of renewables is radically altering the decarbonisation calculation.

The coronavirus pandemic has shattered our sense of invulnerability and reminded us that our world can be turned upside down in unexpected ways. It has also brought the greatest economic shock since the Great Depression. Governments are responding by adopting stimulus packages aimed at reviving their economies.

The good news is that making these kinds of investments has rarely - if ever - been less expensive for governments. Interest rates are hanging around zero, if not negative, all around the world. Over the last five years, the investment for adopting alternative fuel infrastructure has been more than double in emerging countries. It is driving lucrative business opportunities and contributing positively to the environment in terms of emissions and energy supply. Coal demand has been dropped substantially; main reason was COVID-19 pandemic of course but also economies are switching away from coal. However, the day of this high-emissions fossil fuel is not yet finished. There is lot to be done as the 1.5°C road is getting increasingly constrained.

On the other hand, coal prices are still climbing while Europe is facing unprecedented energy crisis with winter approaching.

After almost two years we could attend our first face-to-face meeting at the INTERCEM Conference in September with our cement industry peers. It was quite amazing and had an insightful discussion on alternative fuels and sustainability for the cement industry. Special thanks to Vassiliko Cement for being a good host for the tour of the plant and port facilities. The highlight of the event is, the second wave of alternative fuel usage in the cement industry is driven due to fossil fuels and emissions costs.

I am sure that everyone of us can make a positive contribution to mastering the mammoth tasks facing humanity. I think everyone knows what we can change in the industry. Let's get started!

I hope that you enjoy our latest edition of Co-Processing Magazine!

Kind regards from Duisburg Ruhrort Harbour

Dirk Lechtenberg

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Figure 1: *Fire in Papenburg recycling facility and firefighters putting out the fire (1)*

Fire Protection in RDF Production and Co-Processing Facilities

By Dirk Lechtenberg

On June 23rd I received a phone call early morning at 05:30 am from our plant manager, who was really on edge: "the plant is on fire". I was dismayed. Our Blue River Recycling Ems plant in the port of Papenburg in Germany caught fire, just before starting commissioning.

The first Blue River Recycling plant has been erected near to the river Ems in Papenburg, Germany, at the site of BERA port terminal, where MVW have been handling alternative fuels since 2004. In cooperation with Nehlsen AG as a local partner, one of the five leading waste management companies in Germany, non-recyclable mixed plastics will be used for the production of environmentally friendly alternative fuel in pellets form. The plant's production capacity will achieve up to 100,000 tonnes of pellets annually.

As a rule of thumb, it's not a question "if" co-processing facilities will catch fire, only "when".

Therefore, we've put special attention to installing state-of-the-art fire detection and firefighting system. The system was tested, but not started yet. Fortunately the fire had started in the control room, and the machines were not affected. "Only" the cabling for energy supply and the plant control system, some sensors such as for moisture content, weighing systems, quality control, etc. need to be changed completely due to the high temperatures from the fire.

More than 250 firefighters were on our site; many thanks again for the support of all involved parties from the

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voluntary firefighters, technical support by THW (this is the German Technical Emergency Service), Red Cross, all involved authorities from the city of Papenburg, county of Emsland, and others. With their help, the fire was quickly under control. I am also happy, that nobody was injured. However, it gave us a setback to restart the facility. But we believe “the comeback is always stronger than the setback”.

As I said – it’s not a question if a fire starts in such waste processing and co-processing facilities – but only when. So, I thought it’s time to explain how such fires start and how to avoid them.

Several countries that have been battling severe wildfires have been reported in the news. Forest fires mainly resulting from long dry seasons due to climate change effects such as in Turkey, the Mediterranean area, Russia, Canada, California, and many other locations. Most of these fires result from self-ignition or arson. In waste processing facilities, where mixed or even defined wastes are processed into alternative fuels, the scenario is comparable.

How fires start

In a typical “RDF plant” either mixed waste is accepted and processed, or defined fractions of industrial or presorted waste. In both cases the waste is stored in huge volumes, either loose or baled. According to a study published in the “Fire Safety Journal” [2], “reliable data concerning the frequency of fires in waste storage facilities is not available for all European countries; but a long tradition of maintaining detailed fire statistics in Sweden means that details concerning fires in waste storages in Sweden have been available since the 20th century.” The following chart from that study highlights the reasons for fires in waste storage facilities in Sweden and Norway (Figure 2).

The news about fires in recycling or RDF plants or waste storages are now frequent. I am just putting some “highlights” of fires from the last few weeks which I found in newspaper articles (figure 3, 4 and 5).

Figure 3: *World’s biggest tire graveyard in Kuwait is on fire* [3].

Figure 4: *A devastating explosion occurred in a tank farm in the Chempark in Leverkusen* [4].

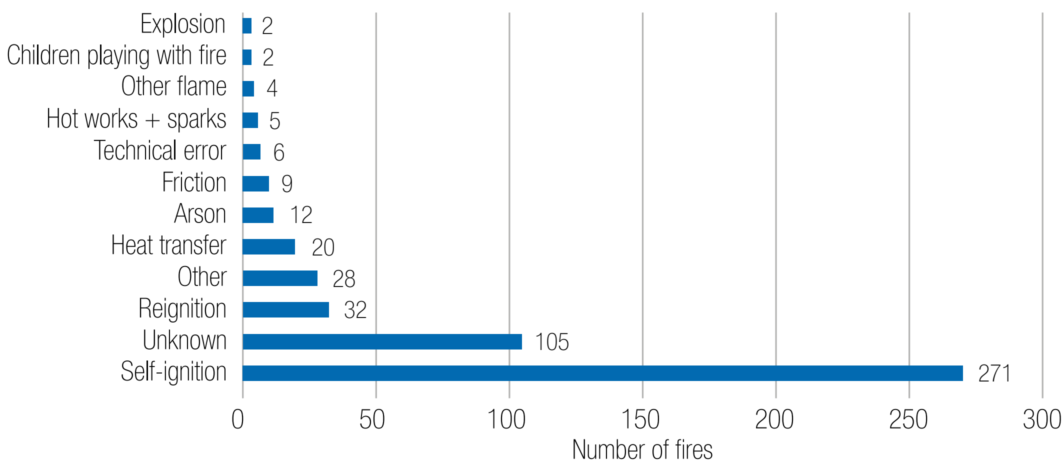

Figure 2: *Summary of ignition sources for fires in waste facilities based on official Swedish fire statistics 2012–2015* [2].

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Figure 5: *A fire in the new sorting facility for plastic waste at Pre-zero Recycling Netherlands* [5].

Besides the explosion in the German hazardous waste incineration plant, these fires started mainly due to self-ignition. Sure, waste materials that are processed into alternative fuels need to have a high calorific value, but how can these wastes self-ignite?

According to the mentioned study, the following waste fractions in figure 6 were thought to lead to the possible incidents of most fire case.

Waste storages as raw materials for RDF contain mainly industrial wastes which consist of mixed plastics, corrugated paper and cardboard, wood, textiles and other non-recyclable wastes. In many cases, only defined or even pre-processed fractions are delivered to cement plants.

Due to high safety standards in the cement industry and the related co-processing plants, an ignition due to hot works (welding or others), children playing with fire and heat transfer can be excluded.

The further sources from Figure 2 are:

- Technical errors
- Friction
- Arson
- Self-ignition

Even when we take a closer look at the point's "friction" or "technical errors", these risks are typically minimized as all drives and gears in a cement plant or co-processing facility are equipped with temperature sensors. The only significant sources of fires being left are:

- Arson
- Self-ignition

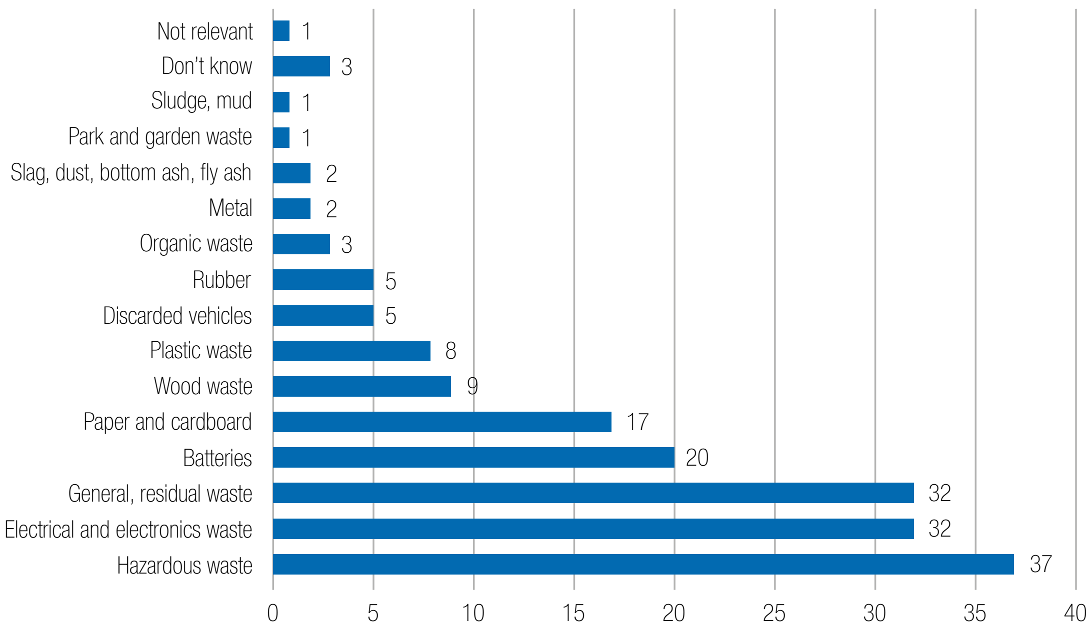

Figure 6: *Summary of the fraction of waste in which most fire incidents occur based on answers to the Norwegian questionnaire* [2].

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Figure 7: *Small battery (left) and burned electrical device with battery (right)*

Let's assume that the cement plants and co-processing facilities are located in enclosed sites with access control, so only "self-ignition" remains as the main risk for fires.

The risk of self-ignition is increased by each of the following steps [6]:

- Biological heat generation, which usually dominates in the range 35–80°C;
- Pyrolysis in the range 80–150°C;
- Smouldering between 150–315°C; and
- Ignition above 315°C.

The main sources of fires in waste and RDF processing facilities can be identified as follows:

- Accumulators and, in particular, lithium batteries of various designs and shapes are the most common cause of the fire (approx. 70%). Due to mechanical damage to the batteries by shredding, in particular, but also during baling, respectively, they are strongly heated by short circuits and resulting in very high currents, thus igniting surrounding plastic objects or catch fire themselves.
- The second most common cause of the fire is containers with flammable gases (e.g. spray cans, butane gas cylinders, etc.). These are predominantly destroyed during the initial crushing process in the processing plant. While crushing the contents of the containers (usually metallic containers) are released and then ignited by sparks or heat generation during the comminution.
- Another cause could be bundled solar radiation. If the input warehouse is not covered, objects made of glass or metal which are dispersed in the stored infeed material might act as burning glass. Even unfavourably parked vehicles and windows of buildings can cause such a phenomenon (but is very unlikely).
- Another reason could be chemical reactions of substances in the input material (extremely unlikely).
- Hot exhaust pipes of vehicles like front-end loaders, fork lifters, or others are sources of fire if not cleaned and parked close to waste piles. Such vehicles always

Figure 8: *Exploded battery*

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Figure 9: *Exploded battery (left) and spray can (right)*

need to be cleaned when not being in operation and parked in dedicated areas away from the waste.

- Dust and waste residues on machines, drives and gears; in many cases, dust ignites on such devices when the plant is not in operation, typically during night hours. It is highly recommended to clean all devices, machines and any places where dust is accumulated on a daily basis.
- Electrical multiple sockets without CE marking and without testing according to "DGUV V3" or "DGUV V4" (DGUV = German Statutory Accident Insurance) or other electrical safety measures bear a high risk of self-ignition after an electrical failure [7]. Such sockets must not be used in facilities.
- Electrical devices such as coffee machines, micro-waves, water heaters can ignite if forgotten; they need to be placed on fire-resistant plates;

Figure 10: *Electrical multiple sockets*

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***Figure 11:** Water heater (left) and burnt-out coffee machine (right)* [8].

- Also, if you store substitute fuels, biological decomposition processes could cause the core temperature of a bale to rise until it ignites itself. As typical waste fractions for the production of RDF should be low in moisture or organic matter, there's a low probability of a biologically triggered self-ignition. However, in many cases, mixed waste is processed (which still contains some organic and sometimes wet fractions of paper, textiles, other biomass), temperatures can increase easily to up to 80°C – even for finished mixed RDF in storages of cement plants. Especially in cement plants, where the RDF is stored over a longer period (e.g. a week and longer) in piles with a height above 4 m, as the material compresses and anaerobic digestion starts. In any case, any waste raw materials and final products such as recyclables, RDF ought to be stored in small confined areas (boxes or bays). The maximum height of storage should not exceed 4 m in blocks or storage boxes not exceeding 400m², separated with concrete blocks of min. 5 m height, allowing for paths of at least 5 m width to enable easy access by the fire brigade.

Such risks may be reduced as much as possible by continuous thermographic scanning and temperature measurements of the whole treatment facility, encompassing storage well as machinery areas.

Summary:

Fire protection in recycling and RDF or co-processing facilities is of utmost importance. With strict guidelines and work instructions, most fires can be avoided. Cleaning of all devices, machines on a daily basis; separate, small storage areas not exceeding a height of 4 m are basic means to prevent a great deal of potential fire sources. Furthermore, understanding that the various strategies (before, during, and after a fire) are linked to each other is crucial to the performance of the actions taken to limit the effects of fires in co-processing facilities. Our findings clearly show that good organization and well-defined procedures for storing waste, preventing or mitigating fires, and communicating with the fire and rescue authorities, including the allocation of work during and after a fire, can deliver substantial advantages.

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Too Heavy or not too Heavy, Is This a Meaningless Question?

By Dr. Hansjörg Diller

1. Intro

On one of our Alternative Fuels Symposia we have carried out a couple of years ago, I had a stimulant chat, among many others, with one of our participants. It was during a break after a lecture session dealing with the pros and cons of co-processing alternative fuels from municipal solid waste. The participant told me that she, although being a layperson, and not being familiar with all the technical details of the lectures, was tremendously impressed by the developments in waste treatment and thermal utilisation. But there was one thing that was really bothering her: "what happens with all the pollutants and heavy metals in the waste if we burn it? There are so many heavy metals in the waste that it cannot be considered healthy if we burn it. What happens to the environment, what happens to my grandchildren?"

Such an incidence is typical when talking about waste. The term "heavy metals" is frequently one of the first to be mentioned when talking about using waste in technical processes. Waste and "heavy metals" are both terms that have negative connotations in the public perception: "Heavy metals" are toxic, they endanger our water, the air, and our health. Reports in the daily press, but also occasionally in specialist publications, give the unsettled reader the impression that heavy metals are fundamentally harmful to the environment or health.

Even in serious television broadcasting, you would encounter, for example, a report entitled "How environmentally harmful is waste incineration in cement plants? ", with the following statements: "In spring we will meet local residents for the first time who are fighting against this waste incineration. Because heavy metals and large quantities of other pollutants are produced in the process." [1]. Such a dilettantish report gives the impression that the evil heavy metals are always produced out of nowhere during waste incineration, just like "other pollutants".

In the field of cement, too, I have observed on several occasions that the term "heavy metals" is used to refer to all kinds of elements (light metals, heavy metals,

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non-metals), when talking about hazardous trace elements in fuels and raw materials. To be honest, as a chemist I'm always a little bit stunned when I hear laypersons using the term "heavy metals". So, I've made up my mind to try to put the record straight on heavy metals.

2. What are heavy metals?

Let's start with a simple question: If there are heavy metals, there must also be light metals, right?

Consulting the "Hollemann-Wiberg" [2], which was my faithful companion textbook throughout my study of chemistry, and has been throughout my professional life, I found the very simple definition on page 644: Light metals have densities of less than 5 g/cm³, all others are heavy metals. There are 15 light metals (lithium, sodium, potassium, rubidium, caesium, francium, beryllium, magnesium, calcium, strontium, barium, aluminium, scandium, yttrium, titanium), and all other metals are heavy metals (like iron, mercury, gold, platinum, lead, nickel, vanadium, zinc, etc.).

A look at a common encyclopaedia – which might be more available to the public than a textbook about chemistry reveals virtually the same definitions: heavy metals have a specific density beyond 5 g/cm³. Light metals are metals and alloys of densities less than around 4 g/cm³, for instance, alkali and earth alkali metals, beryllium, and aluminium [3].

By the way: Metals are "any of a class of substances characterized by high electrical and thermal conductivity as well as by malleability, ductility, and high reflectivity of light. Approximately three-quarters of all known chemical elements are metals. The most abundant varieties in the Earth's crust are aluminium, iron, calcium, sodium, potassium, and magnesium." [4]. Funnily enough, the Encyclopaedia Britannica has also an entry for "heavy metal", which is related to the genre of rock music [5].

It is suggested that beside metals, there must be also non-metals. The most common non-metals are, for instance, carbon (all organic matter like human beings, animals are based on carbon compounds), silicone (main constituent of sand), hydrogen (main constituent of water), oxygen and nitrogen as main elements of ambient air, sulphur, chlorine (constituent of table salt), and many others.

Figure 1: *Typical heavy metals (left to right): Maple Leaf (bullion coin, pure silver); Krugerrand (bullion coin, 91,66% gold, 8,34% copper); 10 euro cent (alloy of copper, zinc, tin, and light metal aluminium); 2 euros (copper, nickel, zinc); 2 euro cent (steel, copper).*

Figure 2: *Typical heavy metals in a household (top to down): pewter cup (95% tin); a spoon (stainless steel "18/10", iron, chromium, nickel); mercury in a glass thermometer (to be handled with care!).*

But I was not satisfied with these definitions, because nothing has been mentioned about poisonousness or other properties which are usually assigned to the term "heavy metals".

Therefore, I had a look at the IUPAC, which is the International Union of Pure and Applied Chemistry. IUPAC is the recognized world authority in developing standards for the naming of chemical elements and compounds. Surprisingly, the term "heavy metal" has never been defined by any authoritative body such as IUPAC. No relationship can be found between density (specific gravity) or any of the other physicochemical concepts that have been used to define heavy metals and the toxicity or ecotoxicity attributed to heavy metals [7].

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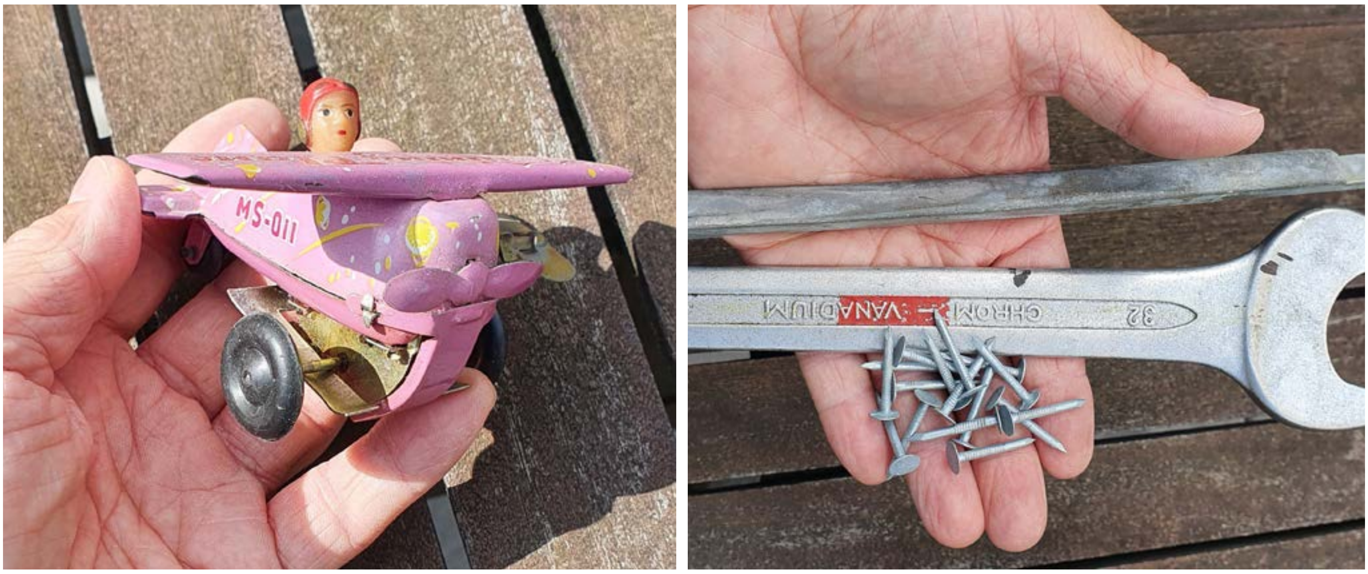

Figure 3: *Typical heavy metals in a household: left picture: a wind-up tin toy (iron); right picture top to down: solder bar (tin, lead); open-end wrench (iron, chromium, vanadium); zinc-plated nails (iron, zinc).*

3. Heavy metals in daily life

People like you and me are surrounded by heavy metals in daily life. A great many people use to sit in and rely on their "heavy metal cages" every day, hoping their cars would take them to work or back home safely. Most car bodies are mainly made of steel (ok, there are also some cars made of light metal aluminium (2,71 g/cm³)), and iron is its basic element. Iron is one of the most common heavy metals (density 7,8 g/cm³). We use it in our daily life, without thinking of any hazardousness, for example, when eating our meal by means of steel forks or knives (ok, there might be another way of menacing human beings with such tools, but this is another story).

People touch heavy metals like copper, nickel, zinc, manganese or others every day when paying with coins. Many coins are made of alloys of various heavy metals, for example, the 2 Euro coin consists of an alloy of heavy metals [9], namely copper (8,9 g/cm³), nickel (8,9 g/cm³), and zinc (7,14 g/cm³), and no one gets sick (except when having too little of money). Others are quite fond of heavy metals like silver (10,5 g/cm³) and gold (19,3 g/cm³) in the form of bullion coins or jewellery.

The photographs show an extract of items made of heavy metals which are used or present in households. However, such heavy metals may find their way into municipal solid waste.

4. Heavy metals in nature and waste

"Heavy metals" are chemical elements, so they belong to the basic materials of matter that make up our earth and the entire universe. Metals as chemical elements can only be transformed, i.e., converted into another chemical bonding form (e.g. copper into copper oxide). In principle, they cannot be made to disappear like organic molecules, which can be broken down into smaller molecules.

Only through natural and human-induced displacement metals can be accumulated locally and removed elsewhere. Natural transformation processes, such as leaching or biological uptake, counteract local enrichment. All metals, but especially essential ones, are subject to a natural cycle.

Being part of the nature, "heavy metals" occur also in raw materials and fuels that are used in all industrial sectors. For instance, the following table 1 provides ranges

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Element	Type of element	Limestone	Clay	Fe_2O_3 additive	Coal	Lignite	Used tyres	Waste oil
		[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
		average	average	low-high	average	average	low-high	low-high
As	metalloid	6	18	4 – 680	7	0.3	n.a.	n.a.
Be	light metal	0.2	3	n.a.	0.9	0.04	n.a.	n.a.
Br-	non-metal	5.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cd	heavy metal	0.07	0.16	0.02 – 15	0.39	0.08	5 – 10	<4
Cl-	non-metal	n.a.	n.a.	n.a.	n.a.	n.a.	<2000	100 – 2200
Cr	heavy metal	9	60	90 – 1,400	25	4.2	<97	<5 – 50
Hg	heavy metal	0.03	0.03	n.a.	0.33	0.07	n.a.	n.a.
Ni	heavy metal	4.5	69	10 – 340	19	2.8	<77	3 – 30
Pb	heavy metal	7	17	9 – 8,700	16	1.1	60 – 760	10 – 21700
Tl	heavy metal	0.27	0.6	0.07 – 400	0.7	0.2	0.3 – 0.3	<0.02
V	heavy metal	45	134	n.a.	30	13	n.a.	n.a.
Zn	heavy metal	23	87	6900 – 9400	85	22	9300 – 20500	240 – 3000

Table 1: *Trace elements in natural raw materials and standard and alternative fuels in the German cement industry [15]*

of elements ("heavy metals", non-metals, metalloids) in materials being used in cement manufacturing.

The numbers show impressively that "heavy metals" are common in natural matter, as well as in waste materials. For the sake of understanding the column "element" does not mean that the materials contain metallic cadmium, mercury and so on. In regular chemical analysis, the materials are subject to special digestion which turns any element into its ionic form to make it available for pertinent quantitative analysis.

5. What about hazardousness?

The hazardousness of a chemical element (a light metal, a heavy metal, a non-metal) depends on its chemical state, the element itself, as well on the amount that enters the human body. Overexposure to "heavy metals" can result in either acute or chronic poisoning. Whether poisoning occurs depends upon many factors including the amount you are exposed to, how you are exposed, and the chemical form of the metal, as well as your age, nutrition and health status. Acute poisoning is usually the result of high exposure to metal at one time or over a short period of time. For example, swallowing a toy coated with lead or cadmium may cause severe symptoms. In order not to overstretch the limited space of our Co-Processing Magazine, I will cater to only some of the "heavy metals" in the paragraphs to follow.

5.1. Chromium

The toxic effect of a particular heavy metal depends decisively on the respective chemical form. A prominent example is chromium (7,2 g/cm³). Many items are galvanised by metallic chromium, like it was in particular the case with vehicles in the 1960es and 1970es. To be honest, I was very fond of the chromium appliances of my first car. One can touch the chromium surface without being jeopardized (Figure 4).

Metallic chromium can be turned into ions by dissolving in acids to obtain chromium salts. Then, chromium is no longer a metal: it is no longer shiny and has low thermal and electrical conductivity. In such salts, chromium is either a trivalent ion Cr^{3+} or a hexavalent ion Cr^{6+}. Both species behave completely other than a metal, and one of them is toxic, the other is not. Figure 4 shows the different appearances of chromium.

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Figure 4: *Three different appearances of chromium (from left to right): Chromium metal: A vintage car with chrome-plated radiator grill, bumpers, headlight covers, rear view mirror, wheel arch trims. Chromium as yellow hexavalent salt: Potassium chromate (source: https://de.thpanorama.com/blog/ciencia/cromato-de-potasio-k2cro4-frmula-propiedades-riesgos-y-usos.html). Chromium as trivalent oxide: Chromium (III) oxide (source: http://scholz-farbpigmente.ch/product/chromoxid/)*

Trivalent chromium is valued at pH 7 as a non-soluble hydroxide (actually, chromium hydroxide is a salt) and can only be absorbed by an organism in traces. It is not toxic, and it is surmised that trivalent chromium is an essential part of a membrane receptor of insulin [6]. Because of its green colour chromium oxide is frequently used as a dye.

While trivalent chromium is not toxic, its hexavalent version is hazardous. Contrary to Cr^{3+}, hexavalent chromium forms anions called chromate (CrO_4^{2-}), which are readily soluble in water, and can be readily absorbed by an organism. But contrary to trivalent chromium, Cr(VI) is not an essential element, but is suspected of having a carcinogenic effect [6]. Chromate in cement is a well-recognised cause of allergic contact dermatitis. This adverse effect of chromate is the reason for the mandatory addition of chromate-reducing agents to cement in Europe. Cement and cement-containing mixtures shall not be placed on the market, or used, if they contain, when hydrated, more than 2 mg/kg (0,0002%) soluble chromium VI of the total dry weight of the cement [12]. Chromate is formed in rotary kilns during regular burning of the clinker under oxidising conditions. In natural raw materials, traces of trivalent chromium (not water soluble) are always present, and parts of the traces are oxidised to hexavalent chromium. Additions of reducing agents to the cement convert the water-soluble evil hexavalent chromium into non-soluble trivalent chromium, once mixed with water.

5.2. Mercury

One of the most harmful “heavy metals” is mercury. Its hazardousness has been already described by Plinius Secundis Maior, a Roman scholar, who lived around 2000 years ago. He described the high mortality of workers in mercury mining [6]. Mercury has a density of 13,6 g/cm³, and it is the sole liquid metal at normal ambient conditions. However, it vaporises readily, so mercury vapours can be inhaled (for example, when a mercury thermometer has been broken). Acute poisoning with metallic mercury is rare, but chronic poisoning is more common since the extensive use of this metal in technology [6].

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5.3. Lead

Another prominent candidate of a critical element is lead (11,3 g/cm³). Lead poisoning is historically linked to intensive mining activity in ancient Rome and the Middle Ages. At that time, the consumption of butter was practised as a countermeasure. The list of lead poisoning caused by paints is long (for instance, "white lead", which is lead carbonate/hydroxide, is a bright white dye). The residence time of lead compounds in the body varies: Retention times of 1 month are observed in blood and liver, kidney. The lead ion readily attaches to sulphur-containing compounds (e.g. proteins). Lead compounds are excreted in urine, sweat or as components of hair and nails. The vast majority of incorporated lead, however, is stored in bone, with retention times of around 30 years [6]. The increasing awareness of the toxicity of lead was the reason to prohibit additions of tetraethyl lead to gasoline in the 1990es and early 2000s.

5.4. Essential elements

Several heavy metals are vital for living beings, for example, iron, copper, manganese, vanadium, and zinc. They are designated as biologically essential metals or trace elements. The essential heavy metals may be needed to support key enzymes, act as cofactors, or act in oxidation-reduction reactions [6].

One of the most important heavy metals for the living organism is iron, not in its metallic form, of course, but as bivalent ionic iron (Fe^{2+}). Bivalent iron is an essential constituent of blood. It is the central part of the protein haemoglobin, which transports oxygen from inhaled air to the cells of our body. The element iron gives the blood its typical red colour. Interestingly enough: a human body of 70 kg contains on average 4,2 grams of this "heavy metal" in the form of its ions [6]. Since iron is essential for the living body, overexposure to iron is harmful. Reviews of several case reports indicate that doses in the range of 200-300 mg iron/kg are generally considered lethal (some 14 – 21 grams for a 70 kg person) [11].

Another essential heavy metal is zinc, which is an essential element in several proteins and enzymes like phosphatases, carboanhydrases, alcohol dehydrogenases. A human body contains around 2 grams of zinc, not in the form of the heavy metal, but in the form of the bivalent ion Zn^{2+} [6], which is readily soluble in water and makes it readily available for biochemical processes. Zinc is an important cofactor in the body and is essential for normal function; however, increased levels of zinc can become toxic. Adults should not take up more than 40 mg of zinc. A single shot of 225-450 mg of zinc usually causes vomiting, and fever may occur after inhalation of zinc oxide vapours [10].

While necessary for health and nutrition, excess exposure to the elements can cause cellular damage and disease. Specifically, excess metal ions can interact with DNA, proteins, and cellular components, altering the cell cycle, leading to carcinogenesis, or causing cell death [6].

Further heavy metals, the non-essential trace elements, like mercury, thallium or lead (as mentioned above) are not needed by living organisms. In slightly increased concentrations essential as well as non-essential heavy metals can induce serious damage to health in humans and many other living organisms.

5.5. "Light metals"

Incidentally, also "light metals", namely sodium and potassium, are essential for living organisms. Potassium and sodium are electrolytes needed for the body to function normally and help maintain fluid and blood volume in the body. Of course, these elements are not present in the metal form (metallic sodium (0,968 g/cm³) or potassium (0,856 g/cm³) ignite readily when exposed to water, see also Figure 5), but as salts, which make them readily soluble in water, and hence, in blood.

However, excess sodium in the form of table salt can increase your blood pressure and your risk for heart disease and stroke. A surplus of sodium chloride, which is the common table salt, can be poisoning. The ingestion of approx. 200 g of salt is fatal for adults, as in this

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Figure 5: *Placing a piece of sodium metal in contact with water results in a hefty explosion. (source: https://www.forbes.com/sites/startswithabang/2017/08/05/ask-ethan-whats-the-quantum-reason-that-sodium-and-water-react/?sh=73dfa3417184).*

quantity the ion balance is massively disturbed and the body looses a lot of water through compensatory diuresis [13]. An adult would need to swallow a mug full of salt to get poisoned (I cannot imagine somebody doing this voluntarily).

6. It can't be helped, the term "heavy metal" is meaningless…

Coming back to my encounter at our symposium, I've explained that "heavy metals" are natural constituents of our Earth, which means soil in the garden as well as rocks. "Heavy metals" do not emerge from waste alone (although waste does contain "heavy metals"), and even our human body contains around 7 grams of "heavy metals" on average [6], with major portions of iron, and zinc, and these 7 grams are essential for surviving of human beings. Given a world population of around 7,8 billion, "heavy metals" account for 54,6 million kg. Having heard that, it dawned on her, and her concerns faded away slowly.

What is surprising is the persistence of the term heavy metals and its continuing use in literature, policy, and regulations, with widely varying definitions leading to confusion of thought, failure in communication, and a considerable waste of time and money in fruitless debate [7]. Having said this, the term "heavy metals" is merely an indication of high specific weight, as the word "heavy" implies.

The term "heavy metal" is hopelessly imprecise and thoroughly objectionable, and there is actually no chemical basis for deciding which metals should be included in this category. There is nothing about their significance for the environment and health. When used with connotations of pollution and toxicity, the term heavy metal is the least satisfactory. "Heavy" in conventional usage implies high density, and nothing else. "Metal" in conventional usage refers to the pure element or an alloy of metallic elements. Knowledge of density contributes little to the prediction of biological effects of metals, especially since the elemental metals or their alloys are, in most cases, not the reactive species with which living organisms have to deal [8].

According to Duffus [8] "there is a tendency, unsupported by the facts, to assume that all so-called "heavy metals" and their compounds have highly toxic or ecotoxic properties. This has no basis in chemical or toxicological data. Thus, the term "heavy metals" is both meaningless and misleading".

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Funnily enough, nobody uses the term “carbon” to refer to all carbon compounds (like dioxins, furans, polychlorinated biphenyls (PCBs), polyolefines (plastics), lignins (wood), carbohydrates (sugars), proteins, DNA, hair, skin, etc). If they did, carbon would have to be labeled as a human carcinogen because so many carbon compounds fall into this category [8].

“Heavy metals” are not toxic in principle. It depends on the “heavy metal” itself and the dose, i.e. the quantity of such an element entering the human body. This is valid also for all other elements, regardless of being a heavy metal, a light metal, or a non-metal. Even oxygen can kill us: Oxygen toxicity is lung damage that happens from breathing in too much extra (supplemental) oxygen [16].

To cut a long story short: When talking about environmental effects it’s time to replace the term “heavy metals” with a term that is scientifically correct and meets reality. I’d use the term “heavy metal” only for a special music genre. Instead, I’d advocate for “environmentally relevant trace elements”, because most of the so-called “heavy metals” can be found only in trace amounts of less than 0,01% [15]. Or, perhaps much better, “potentially toxic elements”, which is connected to a more coherent scientific basis [17].

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U.N. Climate Change Report Sounds 'Code Red For Humanity'

"Death knell for coal and fossil fuels, before they destroy our planet"

By Dirk Lechtenberg

This was a part of the Statement of U.N. Secretary-General António Guterres which described the just newly published report from the scientists of the Intergovernmental Panel on Climate Change (IPCC) [1]. Drawing on more than 14,000 scientific studies, the IPCC report gives the most comprehensive and detailed picture yet of how climate change is altering the natural world - and what could still be ahead. A Reuters report [2] highlighted the alerting messages: Unless immediate, rapid, and large-scale action is taken to reduce emissions, the report says, the average global temperature is likely to reach or cross the 1.5-degree Celsius warming threshold within 20 years. The pledges to cut emissions made so far are nowhere near enough to start reducing the level of greenhouse gases - mostly carbon dioxide (CO_2) from burning fossil fuels - accumulated in the atmosphere.

The deadly heat waves, gargantuan hurricanes, and other weather extremes that are already happening will only become more severe.

Even near to my hometown Duisburg Ruhrort in Germany- just 60 km away- entire towns were inundated by water, while train lines and roads were swept away by the flash floods, claiming at least 173 lives.

Forest fires after heat waves in the Mediterranean area, in Russia, Canada casting a harsh light on the region's vulnerability to the effects of global warming and putting pressure to change climate policies.

At the same time the coal mining industry especially in the US and China celebrating a comeback with two-digit growth rates compared to 2020. Mining companies such as Peabody, Glencore, or Whitehaven increasing their values by up to 40% [3]. Coal prices have tripled compared to before Covid-19 values.

I don't know, how I should think about these developments. We know exactly what will happen if we continue

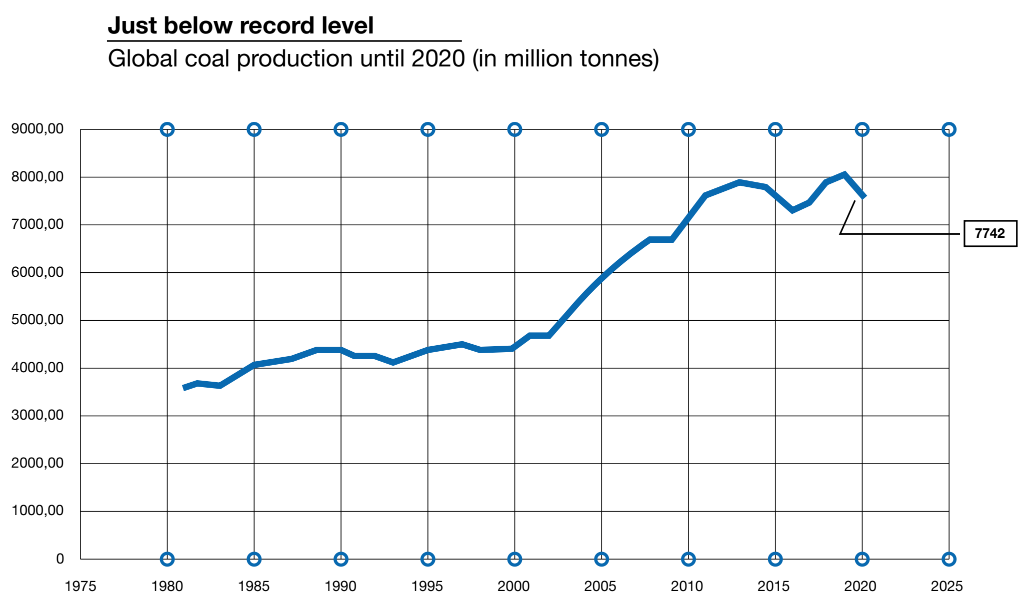

Figure 1: Trend in global coal production [4]

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in this way on polluting our Earth. We know exactly what we can do to combat climate change. But besides political phrases and greenwashing initiatives from the industry nothing is happening.

We have to start now to change our behaviour and to put pressure on governments to transition our society and industry. Using alternative fuels is the easiest way for our industry.

Imagine, the substitution rate across the global cement industry is merely an estimated 5%. In most of the 195 countries worldwide no alternative fuels are used in the industry.

Even in developed countries, average substitution rates stand low at 40-60%. The question is now, why is the cement industry not pushing faster to increase the use of alternative or refused-derived fuels?

CO_2 emissions in the cement industry

Global production of cement has grown very rapidly in recent years, and after fossil fuels and land-use change, it is the third-largest source of anthropogenic emissions of carbon dioxide [5].

There are two aspects of cement production that result in emissions of CO_2. First is the chemical reaction involved in the production of the main component of raw materials for clinker, as carbonates (largely limestone, $CaCO_3$) are decomposed into oxides (largely lime, CaO) and CO_2 by the addition of heat. Stoichiometry directly indicates how much CO_2 is released for a given amount of CaO produced: one tonne of pure limestone releases 440 kg of CO_2, and 560 kg of CaO, or, when referred to one tonne of CaO, 785 kg CO_2 is being emitted These are process-related emissions and cannot be mitigated.

The second source of emissions is from the combustion of fossil fuels to generate the significant energy required to heat the raw materials to well above 1450°C, and these ‘energy’ emissions, including those from purchased electricity, could add a further 60% on top of the process emissions [5].

According to a think tank’s report (6) “globally, the manufacture of cement produces more greenhouse gas emissions than any other single product – about 3 billion tonnes per year, or 8% of the world total”.

However, let’s see what the cement industry can do immediately to reduce fossil-derived carbon emissions. Currently, worldwide clinker production capacity counts around 4 billion tonnes of clinker per year.

China produces the most cement globally by a large margin, at an estimated 2.2 billion metric tonnes in 2020, followed by India at 340 million metric tonnes in the same year. China currently produces over half of the world’s cement. Global cement production is expected to increase from 3.27 billion metric tonnes in 2010 to 4.83 billion metric tonnes in 2030. [7]

The use of alternative fuels- or waste derived fuels is “best practice” in the cement industry, as basically, characteristics of the clinker burning process itself allow environmentally beneficial waste-to-energy and material recycling applications. The essential process characteristics for the use of waste can be summarised as follows [8]:

- Maximum temperatures of approx. 2000°C (main firing system, flame temperature) in rotary kilns
- Gas retention times of about 8 seconds at temperatures above 1200°C in rotary kilns
- Material temperatures of about 1450°C in the sintering zone of the rotary kiln
- Oxidising gas atmosphere in the rotary kiln
- Gas retention time in the secondary firing system of more than 2 seconds at temperatures of above 850°C; in the precalciner, the retention times are correspondingly longer and temperatures are higher
- Solid’s temperatures of 850°C in the secondary firing system and/or the calciner
- Uniform burnout conditions for load fluctuations due to the high temperatures at sufficiently long retention times
- Destruction of any organic pollutants due to the high temperatures at sufficiently long retention times
- Sorption of gaseous components like HF, HCl, SO_2 on alkaline reactants
- High retention capacity for particle-bound “heavy” metals
- Short retention times of exhaust gases in the temperature range are known to lead to ‘denovo-synthesis’ of PCDD/F
- Complete utilisation of fuel ashes as clinker components and hence, simultaneous material recycling (e.g.

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also as a component of the raw material) and energy recovery

- Product-specific wastes are not generated due to a complete material utilisation into the clinker matrix; however, some cement plants dispose of bypass dust
- Chemical-mineralogical incorporation of non-volatile elements into the clinker matrix

Fossil CO_2 reduction scenarios

Let's assume all cement plants in the world would start using alternative fuels. Applying best practice, a thermal substitution rate of 60% can be achieved. If suitable wastes are available, this would be a realistic scenario to reach a 60% substitution rate. A typical RDF has a calorific value of min. 4500 kcal/kg. Typical average energy consumption is assumed with 800 kcal/kg clinker. Of course, modern kilns have a much lower energy consumption, but considering also old kilns, 800 kcal/kg seems to be a realistic number. Let's assume further, that all kilns are fired with coal with an average calorific value of 6400 kcal/kg. Although many kilns are fired with heavy fuel oil, natural gas, pet coke, etc., however, clinker production widely relies still on coal. With currently 4 billion tonnes of clinker production capacity, a quantity of 500 million tonnes of coal would be required.

If we reach a substitution rate of 60%, we will be environmentally friendly by treating more than 426 million tonnes of waste-derived fuels (RDF) and saving around 300 million tonnes of coal. Per year!

The effect on the fossil CO_2 emission reduction would be tremendous: owing to its biogenic content of around 40%, RDF would save around 345 million tonnes of fossil CO_2 emission – every year!

Coal			RDF		
NCV	6.400	kcal/kg	NCV	4.500	kcal/kg
Emission factor	96	t CO_2 / TJ	Emission factor	65	t CO_2 / TJ
(default IPCC)	2,57	t CO_2 / t coal	(around 40% biogenic content)	1,22	t CO_2 / t RDF

		Scenarios			
		0	I	II	III
		Baseline: Coal	20% substitution	40% substitution	60% substitution
Coal	[t/yr]	500.000.000	400.000.000	300.000.000	200.000.000
Emission CO_2 from coal	[tCO_2/yr]	1.286.184.960	1.028.947.968	771.710.976	514.473.984
RDF	[t/yr]	0	142.222.222	284.444.444	426.666.667
Emission fossil CO_2 from RDF	[tCO_2/yr]		174.170.880	348.341.760	522.512.640
Total fossil CO_2 emissions	[tCO_2/yr]	1.286.184.960	1.171.170.190	1.056.155.420	941.140.651
Difference to baseline	[tCO_2/yr]		115.014.770	230.029.540	345.044.309
	[%]		9%	18%	27%

Table 1: *Substitution of coal by RDF, and resulting fossil CO_2 emission scenarios with 20%, 40% and 60% substitution rates.*

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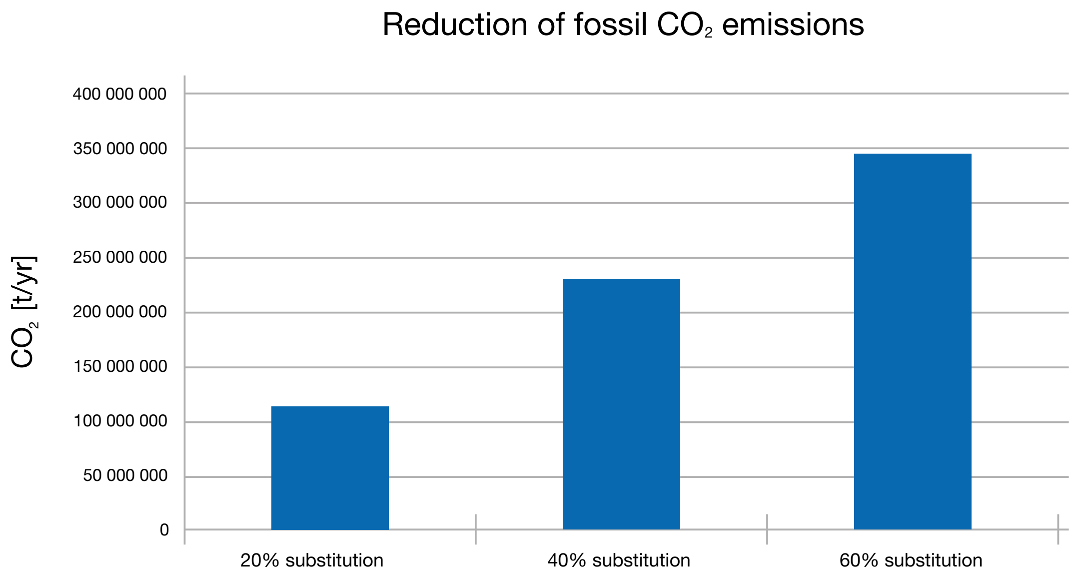

Figure 2: *Reduction of fossil-derived carbon dioxide emissions from global cement industry by substituting coal with RDF.*

Coming back to the question from the beginning of this article: why is the cement industry not implementing such a realistic and easy to establish strategy?

Fossil CO_2 emissions are expensive and, I hope, that the price for CO_2 emissions is going to increase. There are various emission trading systems, e.g. the European Emission trading (EU – ETS). Only recently, the price for one tonne of fossil CO_2 emissions reached more than 50 euro [8].

Other systems are the voluntary systems or carbon removal funds. Polluters can buy "carbon removal certificates" from companies or projects which are reducing fossil CO_2 emissions.

We have calculated the "value" of such carbon removal certificates based on the current European ETS Certificate value of 50€/tonne of CO_2 emissions. Figure 3 shows the impressive result.

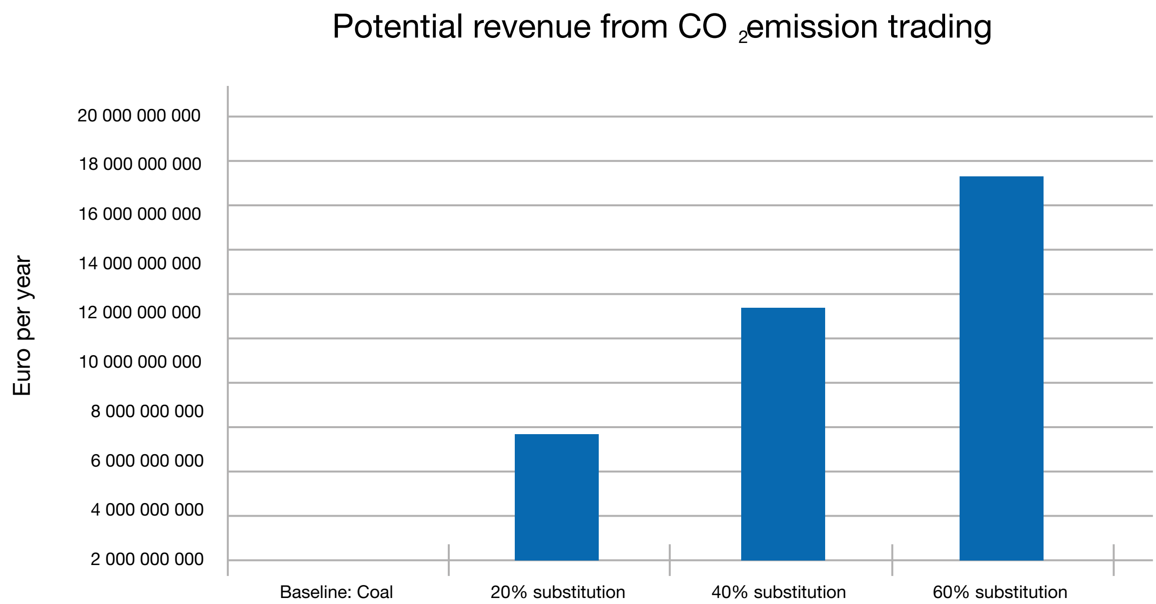

Figure 3: *Potential revenue for cement industry from CO_2 emission trading by substituting coal with RDF*

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With a current certificate price of 50€/tonne of avoided fossil CO_2 emission [9], the cement industry would save around 17 billion € per year. This should be sufficient to finance all needed processing, storage, dosing and feeding systems in the cement plants in connection with RDF - if the industry listens to the "death knell for coal and fossil fuels, before they destroy our planet".

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Figure 1: A typical landfill for municipal solid waste in the southeast of Europe. The smoke in the background emerges from self-ignited waste

A Promising Niche: Waste To Energy for Global South?

By Ankur Saini

Dear Readers, we are living in turbulent times. As the world is recovering from the impact of the Covid-19 pandemic and vaccine rollouts provided a beacon of light. The global economy has taken a hit of over 4 trillion dollars according to UNCTAD [1]. There is much greater economic uncertainty and a global energy shift is now unfolding.

The earliest landfills in human history have been existing since millenniums. Despite the strategy and plans available on hand for waste being reused, recycle, or energetically valorised, landfilling still prevails, and sadly still it plays important role in waste management plan strategies worldwide. As I said earlier, we are living in turbulent times where solutions needed to the current situation and challenges faced now are constantly changing. Many investors are reacting to changing perceptions of "value" as well as new sources of value creation. This article discusses the global perspective and market of waste to energy and the role of alternative fuels towards sustainable development.

Glance On Waste Generation Worldwide

The world population is booming up with changing lifestyles and the consumptions pattern is expected to result in an abrupt change in the waste generation of up to 3.4 billion tonnes of waste by 2050 [2]. By 2050, the volume of waste in low-income countries, particularly in Sub-Saharan Africa, is projected to triple [2, 3].

Municipal Solid Waste (MSW) management is seen as one of the most key considerations in countries throughout the world achieving the Paris Agreement and the 2030 Agenda for Sustainable Development goals.

The global waste generation rate is 0.74 kilograms per capita per day, waste generation numbers are often connected to income levels and rates of urbanization [2]. In high-income countries, daily per capita, waste production is expected to rise 19% by 2050, compared to 40% or more in low – and middle-income countries [4]. At lower income levels, waste generation surged at a quicker rate than at higher income levels. The entire amount of waste generated in low-income nations is

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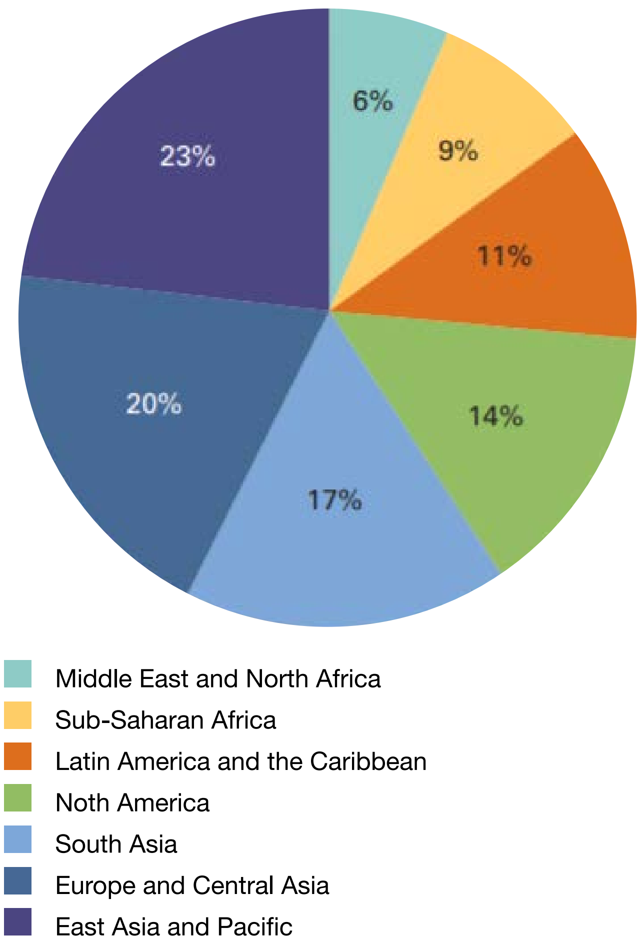

Figure 2: *Waste generation by region in percent in 2016* [2].

projected to more than triple by 2050. The East Asia and Pacific region produce the majority of the world's waste, accounting for 23%, whereas the Middle East and North Africa region generates the least in absolute terms, contributing for 6% [2].

The Waste Trade Between Global North-South

The global waste and recycling sector took a major hit in 2018 when China announced a new policy on banning imports of solid wastes, which remains poorly characterised [5]. Waste trade from the Global North to countries in the South is not a new occurrence. The transfer of plastic waste from the EU to Asia is frequently justified as a means of meeting Global South resource needs [6].

The Basel Convention Plastic Waste Amendments, China's restriction on solid waste imports, and, briefly, the European Green Deal are three of the most recent legal amendments that came into force from January 1, 2021.

Governments agreed to modify the Basel Convention to integrate plastic waste in a legally binding framework during the Basel Conference in May 2019. This amendment, which sets new limits on the transfer of plastic waste that is not meant for environmentally sound recycling, was approved by 186 countries except the USA [7]. The amendments' goal is to better monitor and manage international shipments of most plastic scrap and waste meant for recycling or disposal, making global plastic waste commerce more transparent and controlled.

The decision by China to ban on all materials it classifies as "solid waste", would have far-reaching ramifications for the North economy that have depended on China as a final market for their products up until now [8]. Other economies, like Malaysia, Thailand, and India, have taken efforts recently to ban the import of plastic waste and, in some cases, mixed papers. Rwanda, Kenya, Tanzania, and Uganda raised their taxes on imported second-hand textiles in July 2016 because cheap clothing from abroad was undermining their local industry at the time [9].

In response to pressure from countries in the South, northern economies are being driven to reassess domestic policies and forge new agreements. New laws under the European Commission's European Green Deal are regulating the export, import, and intra-EU shipment of plastic waste. Except for 'clean' plastic waste that is sent for recycling, these new laws prohibit the export of plastic waste from the EU to non-OECD nations [10].

Waste To Energy Approach for Global South

In the global south, a substantial proportion of people still lacks access to electricity, which is vital for poverty reduction through job creation and improved health and education systems. Sustainable energy is seen as a promising way to link economic progress to improved social equity while also saving the environment.

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The problems of ensuring that everyone has access to efficient and affordable energy are numerous, interdependent, and complex. Increased energy efficiency has the potential to significantly minimize energy consumption and carbon emissions. Energy efficiency must thus be integrated as a major measure by policymakers from all sectors in order to positively impact global energy and climate change.

Now the question arises for South economies where to access this huge demand of energy?

The United Nations have already announced the Decade of Sustainable Energy for All (2014-2024), the aim is to promote renewable energy. Despite these new developments and initiatives, however, the world still lacks a more sustainable global energy system. According to estimates of IEA Energy Atlas, renewable energy accounted for 25.2 % of world electricity generation in 2018, whereas since 1990 the average growth of clean energy is calculated by 3.9 % annually [11].

Meanwhile in the global north, substantially able to exploit the MSW as a renewable energy source due to efficient segregation of waste, recycling system and huge infrastructure and hence resulting in good calorific value of waste-derived fuels in incineration or biofuels for industries like cement, lime, brick and others. Comparing to the South which is lacking behind in the infrastructure of MSW management and limitation on materials recycling and energy, lack of regulatory support from the local government, and financial feasibility.

Waste-to-Energy (WtE) has traditionally been linked with incineration, but with the rise of the bioeconomy, it also comprises any processing technology that may generate electricity/heat or produce a waste-derived fuel. Emerging countries in Asia, the middle east, and Africa have recently perceived WtE as a solution to the problems posed by tremendous waste quantities in expanding cities, as well increasingly growing energy demands.

Is WtE alone a sustainable solution for Global South to manage waste?

Though a lot of economies are welcoming this strategy to handle the huge quantity of waste due to rapid urbanisation and booming population in urban areas. Vietnam's largest WtE plant's construction is almost finished, which will treat around 4,000 tonnes of dry solid waste per day [12]. Whereas in India, given the current scenario, Urban Local Bodies are still inefficient in performing or educating residents about source segregation, which results in mixed waste. Without recycling, this mixed waste and sending it to incineration plants are directly affecting the recycling sector economy and thus violating the two 'R's (Reuse and Recycle) out of 5 'R's, (Refuse, Reduce, Reuse, Repurpose and Recycle).

WtE provides an effective and scientific method for minimizing waste mass quantities and hence, saving valuable land area. It is a well-proven technology in most countries, apart from few successful running plants in India the technology was unable to run for a long time because of various reasons, for the Mass Incineration (MI) of MSW. According to Evolution of Waste-to-Energy Technology – An Indian Perspective Projects book raise some arguments regarding this:

- The plant operators lack profound knowledge of the WtE working principle.
- There is no standardization for the procedure since the inappropriate set of technologies was chosen.
- Inefficient combustion due to a mismatch between waste characteristics and plant design.
- Authorities' poor project development benefitted "fly-by-night" operators.
- Ineffective flue gas treatment causing huge emissions.

These downsides were exacerbated by the "Not In My Back Yard — NIMBY" syndrome [13]. As a result, a mindset has evolved for the government's and promoters' unwillingness to establish "good" MSW-based projects.

Urgent Need to Reduce Emissions

Everyone is aware of the fact that solid waste management poses one of the biggest challenges around the globe against environmental impacts, including GHG emissions and ocean plastic accumulation. The greenhouse effect is the primary cause of climate change and there is no uncertainty that alarming levels of GHG are warming up the Earth. Since the late 19th century, the planet's average surface temperature has risen around 1.18 °C, owing largely to rising CO_2 emissions into the atmosphere and other anthropogenic impacts [14]. IPCC climate change report 2021 came up with the latest findings and warning us to brace ourselves as we may reach 1.5 °C of warming

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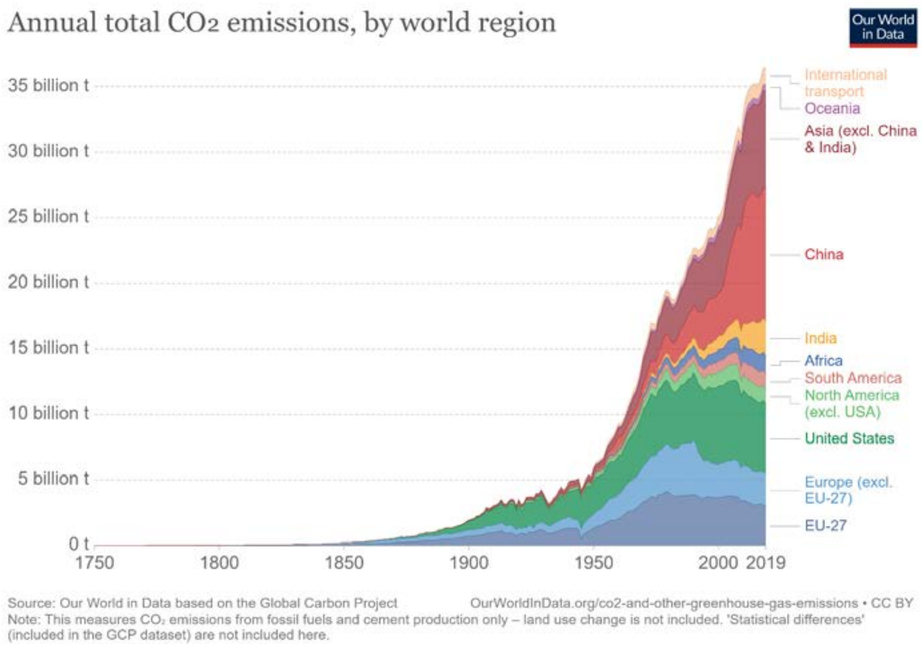

***Figure 3:** The breakdown of global CO_2 emissions by region* [17].

a decade earlier than expected, soon the average global temperature would increase heat waves, lengthen warm seasons and shorten the cold season [15]. The effects can already be seen in the north pole where the European agency reported, the world's largest iceberg, earning a name A-76, has broken off from western Antarctica spotted wandering and floating into the Weddell Sea on May 13, 2021 [16].

Since the beginning of the industrial revolution, carbon dioxide emissions from worldwide fossil fuel burning and industrial activities have increased dramatically.

However, this has changed drastically in recent decades.

Europe and the United States controlled global emissions for most of the 20th century. When it comes to emissions, Europe and the United States accounted for more than 90% in 1900 and more than 86% in 1950 [17]. The rest of the globe, mainly Asia, and most notably China, sees a major increase in emissions in the second half of the 20th century as depicted in figure 3. The United States and Europe currently account for slightly over a third of global emissions. Rapid urbanization has resulted in enormous increases in industry and household consumption, contributing to a rise in waste volumes, including municipal solid waste (MSW), wastewater, hazardous and chemical wastes, and industrial waste.

However, due to the impact of the Covid-19 pandemic, the global CO_2 emissions in 2020 declined by almost 2 billion tonnes [18]. But the global energy demand in 2021 is causing causing further increments of CO_2 emissions, which are expected to climb by 5%, with a rebounding economy demanding coal, oil, and gas in demand [19]. On the other hand, the race to reduce CO_2 is getting stronger, various energy-intensive industries like the cement sector are welcoming the innovations of reducing their carbon footprint by using waste-derived fuels. CO_2 reduction using alternative fuels has much room to grow and various research is conducted to influence the biogenic content or the calorific value of an AF. A good example is a conversion of the non-recyclable waste into fuel pellets and the 'first of its kind' flagship project which will be Pulverised Alternative Fuel (PAF) and has been developed by N+P for Uskmouth coal power station in Wales, UK. This project will remove 500,000 tons of hard

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coal from the market and will save a net 600,000 t/a of CO_2.

The Circular Economy Is About Closing the Loop

EU is not welcoming the strategy of waste to incineration as the future strategy of the European Green deal. The argument made by the EU is clear that waste incineration will decline the practice of recycling and waste prevention. Furthermore, it inhibits rather than facilitates the transition to a circular economy commented by the EU [20]. Waste incineration will no longer receive financial support from the European Union due to its opposition to the transition to a carbon-neutral and circular economy [20]. Rather, higher-performing waste management solutions that embrace the zero-waste objective, such as waste prevention, reuse, and recycling, are widely promoted and funded.

When you think about how much of a pioneer in the circular economy has been Europe, this recent development should serve as an example for the global south to re-evaluate and rethink its path towards sustainability.

Role of Alternative Fuels in Sustainable Development

Where does AF fuels stand in terms of environmental sustainability for the Global South?

Everyone is aware of the fact that global temperature is rising due to GHG emissions. But there is a misconception about the co-processing of waste in industries like cement, lime, and steel that burning in the kiln is an easy-going solution to get rid of all the waste". Every kiln operator needs planning, and experience to operate and comply with rules and regulations for the emissions. The harsh truth, numerous companies on the market are unfamiliar with the operating conditions in emerging countries.

According to International Energy Agency (IEA), there was a drop in global energy demand by 5% in 2020 due to the impact of the Covid-19 pandemic [21]. The assessment by IEA also states that in 2021 the global energy demand is set to increase by 4.6%, which is heading towards significant growth in demand for fossil fuels that would give rise in CO_2 emissions by 5% in 2021 [21]. However, the sector faces challenges from demands for climate change mitigation, the move to cleaner energy forms, and growing competition from alternative resources.

Still, all industries rely on energy coming from non-renewable sources, like coal, oil, gas. In times of overconsumption and an increase in energy demand, we must take transitions towards alternative fuels. 'Sustainable development' has a broad terminology and can be addressed in various forms. Growing concerns about environmental degradation due to fossil fuels consumption can be addressed by usage of alternative fuel and thus helping in a socio-economic matter of economies. Alternative fuels can be less polluting and low carbon sources for future energy demand to Industries.

Conclusion

The scarcity of natural resources and urgent need to check on the environmental impact due to GHG emissions is one of the global challenges faced now by every scale of industries. Energy and emissions are inseparably linked to each other and the harsh truth is a large part of emissions is generated from the use and production of energy.

To address these challenges energy-intensive industries have to come up with generators of renewable energy resources like energy recovery from waste-derived fuels and thus reducing emissions by offsetting the consumption of energy from fossil fuels and landfill methane generation. Countries in the global south should realise the benefits of a circular economy for moving forward, particularly in terms of greening industrial development and dealing with the issues of increasing waste generation. Recycling takes priority over recovery in the waste hierarchy, and waste-to-energy (WtE) conversion comes second over landfilling. There is a trend related to the adoption of non-incineration thermal technologies for energy recovery as a response to public scepticism about waste incineration and it has open up a pathway towards the chemical-physical treatment of waste which also includes co-processing of alternative fuels. To adapt and manage the current climate change there is an urgent need to upgrade the technologies in terms of clean energy production, as carbon capture technologies knowledge is still limited to the world.

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Figure 4: *Industrials waste streams suitable for AF (Source: MVW)*

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Emerging Trends in Thermochemical Recycling for Plastic Waste

By Ankur Saini

The term "plastic" itself means "pliable and easily shaped". It wasn't until recently that it was given a name to a category of materials known as polymers. Polymers are made up of long chains of molecules, and abundant in nature, the name polymer signifies "of many parts".

Humans have discovered how to manufacture synthetic polymers during the last century and a half, sometimes using natural substances like cellulose, but more commonly utilizing the abundant carbon atoms given by petroleum and other fossil fuels. The discovery of synthetic polymers waged a way to our very ecosystem that may be found on the surface of the planet, in the air, and in the deepest ocean depths [1]. It's so long-lasting that the majority of what's been made is still in our ecosystem. It permeates our bodies after making its way into the food chain, flowing from our blood into our organs and even into the human placenta.

According to Statista estimation, the production of plastic waste worldwide in 2019 was around 368 million metric tonnes [2]. That's almost the same as 3,680,000 blue whales or more than 100 times the total population of blue whales [3].

According to the survey report of Conversio Market & Strategy in 2018, around 250 mt of plastic waste was generated globally, from which just 14% of plastic waste is collected for material recycling. The remainder is incinerated, landfilled and exported or unaccounted for [4].

Whereas in EU 28countries+ Norway and Switzerland had a 31% recycling rate from the total waste collected, that is around 9.4 mt of plastics were collected for recycling, with 1.95 mt were exported for recycling, mostly to Asian countries [5]. However, in Europe, more plastic waste is incinerated than recycled, which the European Court of Auditors blame on a shortage of facilities according to Reuters news [6], which could make it difficult to meet the target recycling rate of 50% for plastic packaging by 2025 and 55% by 2030.

There are currently automated and manual processes for sorting plastics. To identify the type of polymer, near-infrared (NIR) technologies are used, while optical colour identification sorts polymers into clear and coloured categories. As well as the X-rays, density and electrostatics technologies, there are several other sorting technologies such as hydrocyclones, ballistic separators and air-classifiers [7].

Million t/a	World (2018)	EU 28+2 (2018) *	Germany (2019) **
Plastic production	360	61.8	20.2
Plastic waste generated	250	30	12.1
Plastic waste collected	175	29.1	6.3
Landfill	75	7.2	<0.1
Energy recovery	50	12.4	3.3
Recycling	50	9.4 (export 1.95)	2.9 (export 0.6)

Table 1: *World, EU 28+2* (4) and Germany linear plastics production to further treatment flow estimation*** [5]

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Some of these methods of these methods are based on the chemical composition of the bulk polymer. There are limitations to mechanical recycling since sorting technologies to distinguish food-grade plastics, which attract higher prices, from other recyclates are not presently available at scale [7].

Classification of Chemical Recycling

Before discussing the chemical recycling of plastic waste, it is important to remember that this broad category includes a variety of processes [8]. We'll take a closer look at three of them in the following flow chart:

The conversion of plastic polymers into monomers, chemical building blocks, or basic chemicals is referred to as chemical recycling [9]. Although there is no exact definition for this as the process itself is in the development phase.

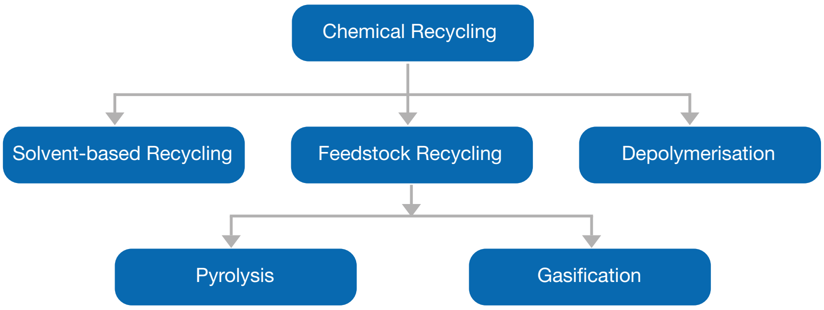

Figure 1: *Classification of chemical recycling according to EU* [8].

Researchers are arguing that chemical recycling has the potential to overcome some of the drawbacks of mechanical recycling. Compared to mechanical recycling, especially thermochemical (feedstock recycling) conversion is more tolerant of mixed and contaminated plastic waste streams and may break down polymers into single monomers to create a high-quality end product depending on the contamination of the material [10].

But the question is, are chemical recycling technologies prepared to help the world handle the challenges of plastic recycling?

Pyrolysis and gasification as feedstock recycling technologies for plastic waste recycling have been attempted in the past but have been stopped several times due to uncertain economics (11). However, new or improved processes have been in development by both large – and small-scale industries. The Task 36 team of IEA Bioenergy outlined some of the recent progress made thus far in the large-scale application of thermochemical recycling of plastic waste, as well as the challenges and status of these technologies in a recent webinar [12]. The Enerkem factory in Canada, which produces methanol from residual household waste, is one example of a large-scale application of thermochemical recycling plastic waste. In Japan, Show Denko pant is producing hydrogen from the gasification of plastic waste at the end of the process. More successfully operating industrial-scale plants are described in Table 2.

Challenges and Drivers for Thermochemical Recycling

There will be tough competition between virgin fossil fuel feedstock and recycled feedstock from pyrolysis and gasification because of the low cost of oil and gas, along with the comparatively high costs of feedstock recycling (driven partly by energy consumption) makes it challenging in terms of economic feasibility [8]. According to the report published by Umwelt Bundesamt in 2017, it stated plausibility of thermal treatment of waste if it complies with legal requirements (e.g. melting process Japan) and achieving special product properties (e.g. vitrified slag, lowest pollutant content) [19]. Also, there are operational requirements in the treatment of specific fractions (for example, highly toxic or chlorine-containing compounds, or very low-calorific fractions like contaminated soils) in upstream facilities (e.g. at power, cement, lime plants) for thermal substitution of fossil fuels [19].

A German-based lime manufacturer that operates nine lime producing plants mostly located in the Eastern Harz district has setup an 'Ecoloop' pilot plant that has processed waste materials together with lime to produce syngas from the gasification process. According to the project manager of 'Ecoloop' project Roland Müller, the Ecoloop process offers chlorine reduction method combined with a simultaneous concentration of so-called "heavy metals" from waste material that produces syngas having a low content of harmful substances and which are trapped by the lime during gasification process [20]. However, the 'Ecoloop' reactor has faced operational

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Commercial industrial-scale plants in operation			
Plant Name & Location	**Capacity (t/a)**	**Technology**	**Process**
Showa Denko, Kawasaki, Japan	70,0001	Gasification	Ebara Ube process (gasification of plastic waste using partial oxidation with oxygen and steam, and produces synthesis gases that can be utilized in the synthesis of ammonia, olefins, and other chemicals)
Enerkem, Edmonton, Canada	165,0002	Gasification	Enerkem process (Four stages) Feedstock preparation+ Gasification + Cleaning and conditioning process + Catalytic synthesis and product purification
Nippon Steel Corporation, Hirohata, Japan	200,0003	Pyrolysis	Direct melting process (Coke oven and chemical method)

Industrial Capital Investment projects			
Project Name & Location	**Planned Capacity (t/a)**	**Technology**	**Process**
INEOS-Plastic Energy, London	30,0004	Pyrolysis	Thermal Anaerobic Conversion (TAC)
Project Beacon, Perthshire, Scotland	7,0005	Gasification	RT7000 proprietary tech (It uses thermal cracker which breaks down the long chains of polymers into shorter chains through the use of heat in the absence of oxygen)
Sabic-Plastic Energy, Geleen, Netherlands	20,0006	Pyrolysis	Thermal Anaerobic Conversion (TAC)
BASF-Quantafuel-Remondis, Oslo, Norway	-	Pyrolysis	-

Table 2: *Thermochemical recycling of plastic waste commercial-scale plants and planned projects.*
Source: [13, 14, 15, 16, 17, 18]

difficulties due to clogging but Ecoloop has been trying to market this system. It would take several years for investments to become viable in the thermochemical recycling infrastructure [8]. Yet, this technology is seen as a silver bullet solution to address mixed and contaminated streams of plastics.

Current methodologies such as LCA tools are insufficient to deal with feedstock recycling (pyrolysis and gasification) to assess and compare environmental and social impacts of recycling technologies [8]. However, with increased awareness of GHG emissions from unsorted waste and also compared to waste incineration, chemical conversion such as pyrolysis, gasification and also co-processing of biomass, this method seems to be a viable option for contributing to climate and environmental goals.

Conclusion

In a circular economy of plastics, thermochemical recycling of plastic waste can play an important role in addressing contamination, mixing and slow degradation of plastic. Yet, a huge problem lies ahead in treating mixed plastics from MSW, even after a thorough separation of plastics from MSW, the plastics will be "dirty" and contaminated. Waste to incineration still prevails the state-of-the-art for the treatment for MSW but talking about plastic waste pyrolysis and gasification can become a plausible solution of getting bigger quantities and higher quality for reprocessing it. In the future, alternative thermal waste treatment methods or thermochemical recycling, such as pyrolysis and gasification, can be promoted as part of a waste management system optimisation approach (especially treating the plastic waste) aimed at lowering GHG emissions and minimizing environmental impacts.

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Company news

Insights

It seems that the global cement and lime industry has now realized, that – besides the carbon footprint reduction – alternative fuel and raw material projects are overall the easiest solutions to fulfil the industrial commitments for sustainable cement and lime production. Almost daily we get new inquiries from the industry across the globe to develop alternative fuel projects or organize in-house trainings and workshops for the AF development or just to supply alternative fuels. Therefore, we are constantly growing our team.

MVW Lechtenberg & Partner is glad to welcoming **Ankur Saini** to the team! Ankur has a Bachelor of Civil Engineering from the Gujarat Technological University, India and a Master of Science – Water Resources and Environmental Management from the Leibniz University Hannover, Germany, specialised in Solid Waste Management, Recycling and Circular Economy, Environmental Data Analysis and participated in a Research Project on "Potential of Refused Derived Fuel in India"

We are happy that Ankur joins our project team for the current projects in worldwide.

MVW Lechtenberg & Partner is glad to welcoming **Stephan Wehning** to the team! He joined our company in June and will support us in further development.

Stephan comes from HeidelbergCement Group in Germany where he worked in various positions for 24 years. He was authorised officer and plant manager of the plant Schelklingen, as well as plant manager in HC's cement works in Ennigerloh, Germany, and responsible for several cement plants in the course of his career. In the last year, he was also a member of the Supervisory Board of HeidelbergCement. His main focus lays on operational excellence, which he leads by supporting companies in energy and technology transitions as well as developing our own Blue River Recycling plants.

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Dirk Lechtenberg participated as a speaker in the INTERCEM Mediterranean Rim Cement Forum

With leading cement industry experts providing detailed news, analysis, and market projections from across Southern Europe, Northern Africa, and the Levant, the **INTERCEM Mediterranean Rim Cement Forum** has looked at cement production, trading, shipping, logistics, and exports across the Mediterranean region.

Dirk Lechtenberg shared his insightful presentation on **29th September 2021** on current trends in EU emission trading and opportunities for the cement industry outside Europe how they can participate in the emission trading system.

Dirk Lechtenberg elected as Board Member

City Cement Company (Kingdom of Saudi Arabia) has founded a subsidiary, "Green Solutions for Environmental Services" focusing on the development of alternative fuel solutions for City Cement Company.

Dirk Lechtenberg joined the Board, under the Chairman Mr. Badr bin Omar Alabdullatif, besides other functions Vice Chairman of the Board of Directors, Managing Director and Chairman of the Executive Committee, as well as Board Member and Member of the Audit Committee, Alabdullatif Holding Group;

Mr. Mohammed bin Hikmat Al-Zaiem, besides other functions Board Member and Chairman of the Audit Committee, City Cement Company;

Majid bin Abdurrahman Al-Osailan, besides other functions Chairman of The Board at Natural Gas Distribution Company (NGDC), Board Member and CEO, City Cement;

Saleh bin Ibrahim Al-Shabnan, CEO, besides other functions Haffaz for Consultation and Business Development, Vice Chairman of Exports' Society, Chairman of Supply Chain and Procurement Society and Head of Jury Committee, Gulf Petrochemicals and Chemicals Association

The company is operating two tyre processing facilities as well as a municipal solid waste processing and RDF production line – the first of its kind in the Kingdom.

Inspired by the Kingdom's 2030 vision and ambition to effectively contribute to achieving the set global sustainability targets, GSFES was founded by the minds and the hands of competent Saudi cadres.

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America – US

Lafargeholcim and the US Army Corps of Engineers Have Reached an Agreement to Recycle Construction and Demolition Waste.

LafargeHolcim, Switzerland and its subsidiary, Geocycle, announced a cooperative agreement research project with the Engineer Research and Development Center (ERDC) of the United States Army Corps of Engineers to explore how construction and demolition (C&D) materials can be used for energy recovery and mineral recycling.

ERDC will provide technical assistance and $3.4 million for a waste characterization study and a basic research program to demonstrate how C&D debris from across U.S. military facilities can be used to create alternative fuels and alternative raw materials for the production of new, more sustainable construction materials, as part of this agreement.

Source: Construction & Demolition Recycling: "Lafarge-Holcim, U.S. Army Corps of Engineers Announce Agreement to Recycle C&D Material." Published 22 July 2021, https://www.wastetodaymagazine.com/article/lafargeholcim-army-corp-construction-demolition-recycling/

America – US

From Waste to Commodity

Entsorga West Virginia LLC converts municipal solid waste and non-hazardous byproduct materials from commercial and industrial (C&I) operations into alternative fuels, clean energy. Argos USA's Martinsburg plant in West Virginia has been fulfilling the rising demand for solid recovered fuels, resulting in environmental advantages and lower operating costs.

The first facility of its kind in the United States is Entsorga West Virginia LLC (EWV), which is owned by ReFuel America, a consolidated subsidiary of BioHiTech Global. The patented High-Efficiency Biological Treatment is being used.

Source: International Cement Review: "From Waste to Commodity." Published 17 May 2021, https://www.cemnet.com/Articles/story/170798/from-waste-to-commodity.html

South America – Brazil

Stadler Constructs Brazil`s Largest Mechanical Sorting Facility

Stadler recently agreed to develop the largest mechanical sorting facility in Brazil with Orizon Valorizaço de Resduos.

This will be the nation's biggest mechanical sorting facility. The whole project has been developed and implemented by Stadler with two main goals: to modernize and reinforce Orizon's sorting facility, and to pick the highest-value recoverable materials to meet the demands of increasingly demanding domestic and international markets.

There are five ecoparks operated by Orizon Valorização de Resíduos in Brazil, and its waste management and processing facilities handle roughly 4.6 million tonnes of waste each year, serving approximately 20 million people and more than 500 corporate clients. In the future, the company will repeat the initiative in other sites around the country due to its effectiveness and significance. (RECYCLING magazine)

Source: Recycling magazine: "Stadler Builds Largest Mechanical Sorting Plant in Brazil." Published 08 July 2021, https://www.recycling-magazine.com/2021/07/08/stadler-builds-largest-mechanical-sorting-plant-in-brazil/

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Europe – UK

Cauldon Plant Invests GBP 13 Million in Lowering Its CO_2 Emissions.

Lafarge Cement is constructing a new pre-processing facility for the storage, handling, and feeding of solid alternative fuels that have been reclaimed from landfills. A new chloride bypass will also be constructed, ensuring product quality while producing no additional waste.

Cauldon was the country's first dry-process cement mill. It is a subsidiary of LafargeHolcim's Aggregate Industries. This expenditure is expected to lower the company's carbon dioxide emissions by 30,000 tonnes per year.

Source: The Construction Index: "Green Investment for Cauldon Cement Works." Published 11 June 2021, https://www.theconstructionindex.co.uk/news/view/green-investment-for-cauldon-cement-works

Europe – Sweden

HeidelbergCement Plans to Build World`s First Carbon-Neutral Cement Plant

On the Swedish island of Gotland, HeidelbergCement intends to upgrade its plant to become the world's first carbon-neutral plant by 2030. The system will be ramped up to capture up to 1.8 million tpy of CO_2 at HeidelbergCement's subsidiary Cementa Slite plant, which corresponds to the plant's total emissions. Furthermore, the use of biobased fuels in cement production at Slite will be boosted in accordance with the Group's goal to significantly increase the share of biomass in the fuel mix.

Source: World Cement. "HeidelbergCement to Build Carbon-Neutral Cement Plant." Published 3 June 2021, https://www.worldcement.com/europe-cis/03062021/heidelbergcement-to-build-carbon-neutral-cement-plant/

Europe – Ireland

Irish Cement`s Limerick Plans Are Subject to A Second High Court Review

Irish Cement's operating license has been challenged in court by the daughter of JP McManus, Sue Ann Foley.

Judicial review was ordered in an affidavit filed on Monday, raising issues about the decision-making process surrounding Irish Cement's license application.

Ireland's largest cement manufacturer, Irish Cement, announced in May that it would switch from fossil fuels to solid recovered waste and other fuels at its Mungret facility. It's the second court review of the EPA's decision, the first having been requested by city solicitor Michelle Hayes, president of Environmental Trust Ireland. The decision to give a license to Irish Cement has caused resentment in Limerick, with more than 3,000 individuals writing to the Environmental Protection Agency (EPA) expressing concern over the changes' impact on the local ecology.

The company has long claimed that the improvements would have no environmental impact because the material would be burned at such a high temperature. It is also stated that the €10 million strategy must be implemented in order for the plant to remain competitive and protect local jobs.

Source: Limerick Leader: "Second High Court Review Sought Over Irish Cement's Limerick Plans." Published 13 July. 2021, https://www.limerickleader.ie/news/home/648958/second-high-court-review-sought-over-irish-cement-s-limerick-plans.html

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Europe – France

FlSmidth and Vicat Have Announced the Installation of Europe`s First Full-Scale Clay Calcination System

FLSmidth and Vicat have announced the installation of Europe's first full-scale clay calcination plant. Equipment will be delivered by FLSmidth to replace clinker in a new cement production in France with ecologically friendly clay, reducing CO_2 emissions by up to 16% compared to existing cements. An environmental control system and alternate fuel storage are included in the order from FLSmidth. The project's final commissioning is planned for the end of 2023.

Source: World Cement. "FLSmidth Announces Europe's First Full-Scale Clay Calcination Installation with Vicat." Published 29 June 2021,https://www.worldcement.com/europe-cis/29062021/flsmidth-announces-europes-first-full-scale-clay-calcination-installation-with-vicat/

Europe – France

Merger Agreement Between Veolia and Suez Has Been Formalized

Following approval of the latest terms for their merger by their respective Boards of Directors, Veolia and Suez signed a merger agreement on Friday (May 14). Earlier this year, Veolia and Suez concluded an acquisition deal, in which Veolia committed to buy the remaining 70.1% of Suez it does not already own for €20.50 a share.

According to a joint statement made by the two companies, the Combination Agreement ensures that the purchase will go forward at that share price and will enable Veolia to acquire the assets needed to fulfill its aim of becoming a "global champion in ecological transformation." (Resource Magazine)

Source: Resource Magazine. "Veolia and SUEZ Formalise Merger Agreement." Published 18 May 2021, https://resource.co/article/veolia-and-suez-formalise-merger-agreement

Europe – Germany

Märker Zement`s Alternative Fuel Project Is Won by Beumer Group

Märker Zement GmbH has entrusted Beumer Group to provide a single-source solution to effectively transport and store alternative fuel materials at its Harburg facility in Germany. This really is the system provider's largest order to date in this business segment.

The order covers everything from receiving and unloading vehicles to storing, transporting, and feeding solid alternative fuels. Beumer Group will construct an intermediate storage facility and install a pipe conveyor to connect it to the customer's new warehouse. For the main burner, there is also a link to the new preheater and the existing warehouse. A fully automated overhead crane, buffer bins and magnetic separators, a screen, and a pipe conveyor feeding station are all located throughout the warehouse. A 700-meter pipe conveyor is the system's most important component.

The line will process two types of residue-derived fuel (RDF), each with a distinct material grain size and calorific value, as well as shredded tyres, commonly known as 'tyre-derived fuel' (TDF). It will have a maximum capacity of 40 tonnes per hour. The mechanical and electrical installation, as well as commissioning, will be handled by Beumer Group.

Source: International Cement Review. "Beumer Group Wins Märker Zement Alternative Fuel Project." Published 16 June 2021, https://www.cemnet.com/News/story/170942/beumer-group-wins-m-rker-zement-alternative-fuel-project.html

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Europe – Hungary

At Lafarge Hungary`s Királyegyháza Cement Factory, A TEC Was Awarded a Contract for Alternative Fuels Flash Dryers

Lafarge Hungary, a subsidiary of LafargeHolcim, has awarded a contract for the delivery of an alternative fuel (AF) flash dryer for the 1.0Mt/yr kiln line at its Királyegyháza cement plant in Baranya County to German-based Loesche subsidiary A TEC. The dryer will use remaining hot gas from the chlorine bypass system in combination with a satellite burner to fire the material in the kiln, according to the supplier. A new AF receiving, processing, and dosing system for a second AF flow firing directly into the kiln burner is also part of the project. According to A TEC, the project will be completed in the second quarter of 2021, following the conclusion of the plant's winter closure in 2020/2021.

Source: Global Cement. "A TEC Wins Alternative Fuels Flash Dryer Contract at Lafarge Hungary's Királyegyháza Cement Plant." Published 29 March 2021, https://www.globalcement.com/news/item/12193-a-tec-wins-alternative-fuels-flash-dryer-contract-at-lafarge-hungary-s-kiralyegyhaza-cement-plant

Asia – India

The Reddipalayam Cement Works Has Reached a Milestone of 25% Alternative Fuel Usage

The Reddipalayam Cement Works, an integrated plant of UltraTech Cement in the Ariyalur district, has met one-fourth of its fuel (heat) requirement by utilizing waste materials supplied from nearby municipal bodies and industries.

According to a press release from the corporation, the plant has also decreased CO_2 emissions by 2,250 tonnes per year.

Municipal waste is collected from 11 local municipalities, including Ariyalur, Erode, Kumbakonam, Thanjavur, Perambalur, and Karur, as well as places like Chennai and Kozikhode. This waste is co-processed as an alternative fuel in its cement kilns.

The alternative fuels effort has helped minimize air and soil pollution in cities while also reducing the burden on landfills. Reddipalayam Cement Works also co-processes plastic waste from the paper industry in Karur, Tiruchi, and Coimbatore, among other towns in Tamil Nadu. Alternative fuels for the unit include refuse derived fuel (RDF) from professional organizations and industrial waste from Tamil Nadu-based industries.

Source: The Hindu: "Reddipalayam Cement Works Achieves 25% Alternative Fuels Utilisation Milestone." Published 29 June 2021, https://www.thehindu.com/news/cities/Tiruchirapalli/reddipalayam-cement-works-achieves-25-alternative-fuels-utilisation-milestone/article35037257.ece

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Asia – Philippines

The RiveRecycle Initiative Aims to Remove Plastics from Rivers to Be Reprocessed into Fuels

RiverRecycle and Clean Planet Energy have teamed up to promote global efforts to remove non-recyclable plastics from Southeast Asia's rivers and environment. After that, the waste will be recycled into new ultra-clean fuels.

The waste management systems are built by RiverRecycle on the banks of the world's most polluted rivers, allowing for the collecting of plastic waste and floating debris and thereby enabling the creation of a local circular economy. Clean Planet Energy develops and manages ecoPlants, which are ecologically beneficial facilities that convert non-recyclable plastic waste into circular goods that can be used to replace fossil fuels.

Source: Recycling Magazine: "RiverRecycle and Clean Planet Energy Have Partnered to Support Global Efforts of Removing." Published 29 July 2021, https://www.recyclingproductnews.com/article/36982/riverrecycle-partnership-aims-to-remove-plastics-from-rivers-to-be-re-purposed-into-fuels

Asia – South Korea

BMH Technology Has Been Awarded a High-Capacity Waste Shredding Contract

SsangYong C&E's facilities in Donghae and YeongWol, South Korea, will get three waste shredding lines from BMH Technology Oy. The lines will generate high-quality solid recovered fuel (SRF) for use in cement kilns and boilers.

For impurity separation, each line comprises a TYRANNOSAURUS® FineScreen and an air classifier. Five high-capacity TYRANNOSAURUS ® FineShredders are included in the shipment.

Donghae will have one of the largest SRF shredding factories in the world, providing alternative cement fuel. The capacity of the Donghae facility is 80tph, with two lines and four shredders, generating particle sizes below 25mm. In the autumn 2021, the lines will be handed over to the customer.

Source: International Cement Review: "BMH Technology Wins High-Capacity Waste Shredding Order." Published 23 April 2021, https://www.cemnet.com/News/story/170672/bmh-technology-wins-high-capacity-waste-shredding-order.html

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Asia – Vietnam

The Installation of Vietnam`s Largest Waste-To-Energy Plant Is Nearing Completion

In late 2017, Hanoi's administration authorized the Soc Son Waste-to-Energy (WtE) project in Nam Son Waste Treatment Complex, which will cost VND7 trillion ($303 million).

The work is expected to be finished and operations will begin in September. With a capacity of 4,000 tonnes of dry solid waste each day, it will be the largest in Vietnam and the second largest in the world once finished. Thien Y Environmental Energy JSC of Hanoi is the project's investor, while Chinese Metallurgical Group Corporation General Contractor MCC is the project's contractor (China).

Source: Waste Management World: "Vietnam's Largest Waste-to-Energy Plant Nears Completion." Published 28 June 2021, www.waste-management-world.com/a/vietnam-s-largest-waste-to-energy-plant-nears-completion

Caribbean – Jamaica

Caribbean Cement Signs an MoU for the Use of Tyres

The Jamaican government has agreed to use end-of-life pneumatic tyres after signing a Memorandum of Understanding (MoU) with Caribbean Cement Co. The company plans to transform old tyres from landfills into an alternative fuel.

Prime Minister Andrew Holness stated that about 2 million old tyres are created in Jamaica each year, with 185,700 tyres ending up in landfills.

Source: International Cement Review: "Caribbean Cement Signs MoU for Tyre Usage." Published 24 June 2021, www.cemnet.com/News/story/170987/caribbean-cement-signs-mou-for-tyre-usage.html

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Africa – Nigeria

Vetiva Sees a Bright Future for the Cement Industry

Stronger capital disbursements from the public sector, according to Vetiva Research, would boost optimism in the cement business in Nigeria.

Vetiva cited the federal government's increasing attention on transportation infrastructure projects as a significant driver of its expectations, with the goal of positioning the transportation industry ahead of the recently formed African Continental Free Trade Area (AfCFTA).

Although it indicated that a high budget deficit (N5 trillion) might jeopardize capital expenditure (CAPEX) execution, it remained confident that the government would be able to secure sufficient funding to cover a significant amount of the funds through debt financing.

According to the industrial Goods Analyst at Vetiva Research, Onyeka Ijeoma, commented that Dangote Cement Plc has established an Alternative Fuels (AF) strategy in order to better control its energy expenses, while Lafarge Africa Plc plans to increase its AF usage. (THISDAYLIVE)

Source: This Daily Live: "Vetiva Predicts Bright Prospects for Cement Sector." Published 21 July 2021, https://www.thisdaylive.com/index.php/2021/07/21/vetiva-predicts-bright-prospects-for-cement-sector/

Australia

Toxic Waste Rebranded: Australia Prohibits Third-World Dumping but Leaves a Massive Toxic Loophole

Prime Minister Scott Morrison and Federal Minister for the Environment Sussan Ley announced Australia's export restriction implementation as part of the Recycling and Waste Reduction Act 2020 in a press release in December last year.

Exports of glass waste were prohibited at the start of the year, while mixed plastics were banned in July 2021. Other materials including paper, tyres, and single polymers like plastic bottles and containers will gradually be phased out by 2024.

Source: Michael West Media: "Toxic Waste Rebranded: Australia Bans Third World Dumping, Leaves Giant Toxic Loophole." Published 21 July 2021, https://www.ban.org/news/2021/7/21/toxic-waste-rebranded-australia-bans-third-world-dumping-leaves-giant-toxic-loophole

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MVW Lechtenberg
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Beteiligungsgesellschaft mbH

Geschäftsführer
Dirk Lechtenberg
Dammstr. 11a,
D – 47119 Duisburg Ruhrort

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:
magazine@lechtenberg-partner.de

www.lechtenberg-partner.de