

Overcoming AF challenges in achieving carbon neutrality

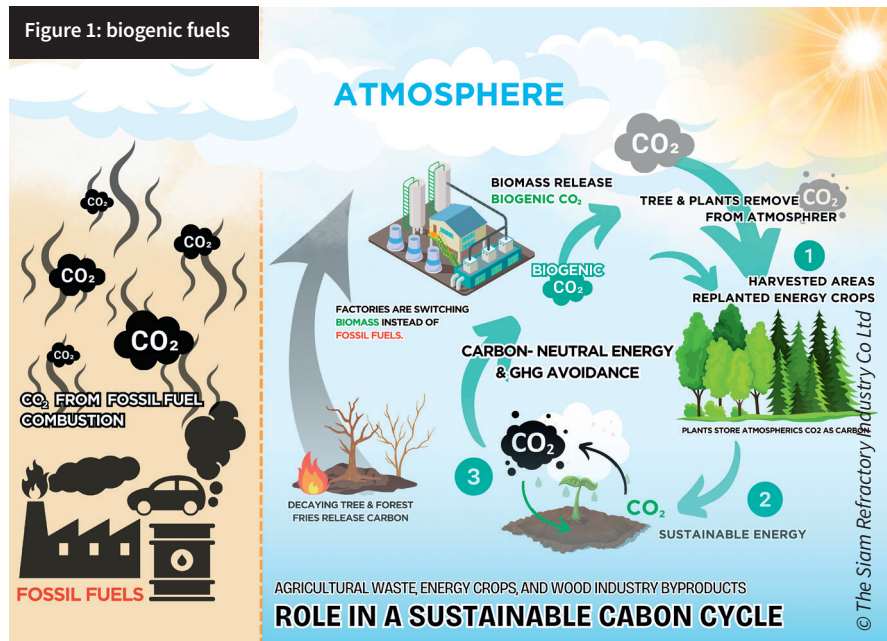
The operational challenges posed by climate change and energy shortages in cement production have led to a growing emphasis on adopting alternative fuels (AFs), particularly biomass, to reduce greenhouse gas emissions and improve energy security. SCG Cement and Green Solution Business' success in integrating AFs is a notable example. However, to ensure smooth operations, potential issues such as clogging and abrasion in the production process must be proactively managed.

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Alternative fuels (AFs), particularly biomass fuel, offer a compelling solution to the cement industry's challenges of decarbonisation and high energy costs. They support the sector's need for energy security as well as mitigating the impact of the increasing cost of greenhouse gas emissions, including CO₂, on the company's profit and loss sheet.

One notable advantage of biomass fuels, when compared with fossil fuels, is their potential to reduce greenhouse gases. Unlike fossil fuels, which only emit CO₂, energy crops used as biomass fuel can absorb carbon from the environment and release biogenic CO₂ when utilised. This carbon cycle of release and capture can play a significant role in sustainably reducing greenhouse gases in the atmosphere, propelling the cement sector toward carbon-neutrality in the near future.

SCG Cement and Green Solution Business, a strategic partner of The Siam Refractory Industry Co Ltd, prioritises the



utilisation of environmentally friendly construction products and consistently enhances the share of AFs year over year.

In 2019 SCG achieved an AF utilisation rate exceeding 15 per cent, which has surged to 47 per cent by mid-2024. This progress aligns with its overarching initiative to curtail CO₂ emissions and implement a net-zero plan. However, increasing AF use presents a significant challenge, particularly in terms of addressing the issues of clogging in the cement production process and abrasion in the AF transportation system.

A clogging problem

Clogging poses a significant operational challenge in cement production, particularly in instances where a high volume of AF is utilised. While the phenomenon of alkali-chloride-sulphate circulation within the cement kiln is well documented, it is

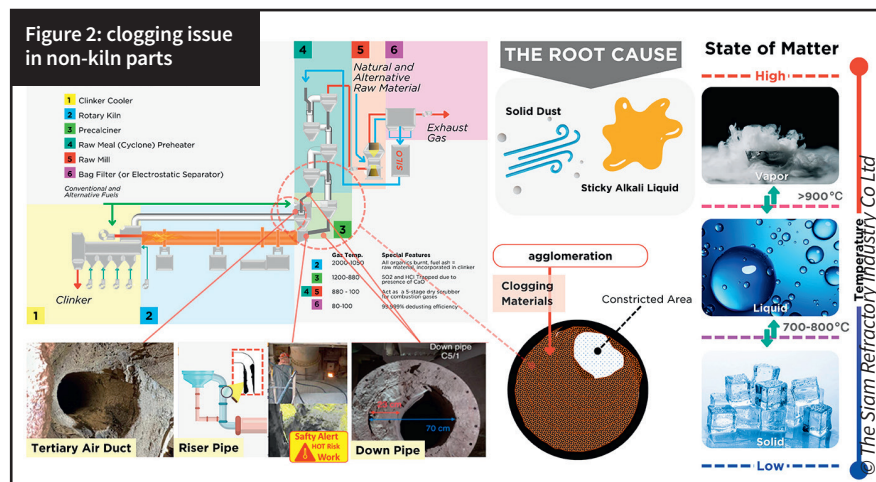


Table 1: melting and boiling points of volatiles in the cement kiln

Compound	Melting point (°C)	Boiling point (°C)
Calcium carbonate – CaCO ₃	825	Decomposes
Calcium chloride – CaCl ₂	772	1670
Calcium fluoride – CaF ₂	1403	2500
Calcium sulphate – CaSO ₄	1450	Decomposes
Potassium carbonate – K ₂ CO ₃	891	Decomposes
Potassium chloride – KCl	770	1500 (sublimes)
Potassium sulphate – K ₂ SO ₄	1067	1689
Sodium carbonate – Na ₂ CO ₃	851	Decomposes
Sodium chloride – NaCl	801	1465
Sodium sulphate – Na ₂ SO ₄	884	-

Figure 3: key features of advanced materials

Excellent Chemical Resistance

Test Material: Clinker with a compound of potassium and sulfur

- Place a sample in a crucible with the test material, and place a weight on top of the mixture.
- Heat this mixture to 1200°C and maintain the temperature for 8 hours.
- After cooling down, examine the test material for any signs of corrosion on the surface.

ADTEX-A92 : No chemical attack

Low Cement Castable : A sign of corrosion

Low Adhesion and Absorption

- Place an adhesion test tablet (a mixture of Cement Cake + Potassium + Sulfur) on sample surface.
- Heat this mixture to 1300°C and maintain the temperature for 5 hours.
- After cooling down, examine the test material for any signs of adhesion on the surface by rubbing it.

ADTEX-A92 : Nonstick

Low Cement Castable : Embedded (Stick)

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imperative to direct attention toward its implications beyond the kiln. The presence of alkali chloride in a liquid state, combined with solid dust within the system, leads to the formation of build-ups on the refractory lining. This occurs within a specific temperature range, typically between 800-1000 °C, contingent upon the chemical composition involved, as shown in the Table 1. These build-up materials manifest as constrictions and blockages in critical areas such as the bottom cyclone preheater, downpipe, riser pipe and tertiary air duct.

While operators may initially perceive this issue as minor, the repercussions of blockages are far-reaching. When material builds up, operations must be halted to clear these, necessitating the undertaking of risky hot work. Frequent halts or pauses for maintenance not only disrupt the operational flow but also have the potential to inflict damage on both the kiln and the refractory bricks within. Hence, it is imperative for cement production operators to gain familiarity with and

undertake proactive measures to address this issue: the alkali-sulphur modulus, liquid phase ratio and CO content should be closely monitored. These practices can mitigate the adverse impact of clogging, sustain smooth operational continuity

and safeguard the integrity of the entire production process.

Preventing material build-ups

The Siam Refractory Industry Co Ltd team has dedicated significant effort to collaborating with its strategic partner in devising a method to enhance AF utilisation in the customer's production process while effectively addressing associated issues. Its successful resolution of the clogging issue involved the implementation of advanced ceramic modules, distinguished by three key attributes:

1. exceptional chemical resistance across a wide temperature range, rendering the material impervious to alkali compounds
2. low-adhesion properties that prevent the accumulation of clogging materials on the equipment surface
3. zero water absorption, mitigating the adherence of clogging materials.

Following the implementation of this build-up prevention solution, the necessity for hot work to clear clogged areas has shown a significant decrease, resulting in a workload reduction of 60-100 per cent. Specifically, there has been a reduction of over 60 per cent in the areas of the riser duct downpipe, clogging issues have been completely eliminated in the installed sections, indicating a 100 per cent improvement. Furthermore, the production processes are no longer subject to interruptions caused by clogging issues, particularly in the cyclone preheater area. The resolution of these challenges has significantly bolstered the stability of the production process, leading to a continuous and effective increase in AF utilisation.

Figure 4: application and results of measures to prevent clogging

CLOGGING in the non-kiln parts

- 1 Clinker Cooler
- 2 Rotary Kiln
- 3 Precalciner
- 4 Raw Meal (Cyclone) Preheater
- 5 Raw Mill
- 6 Bag Filter (or Electrostatic Separator)

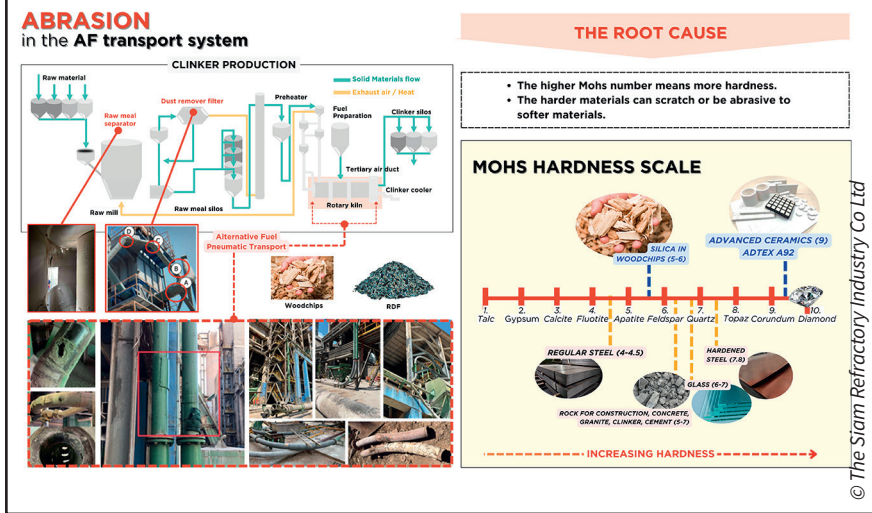
TAD at Siam Cement

Down Pipe at Siam Cement

Riser Pipe at Siam Cement

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Figure 5: abrasion issues in the AF transport system



The issue of abrasion

Industrial pneumatic transport systems are often faced with the overlooked issue of abrasion, which has a significant impact on the overall efficiency of the cement plant. Leakage of the solid fuel or raw materials being transported often leads to dirt and dust emissions, which depending on their hardness, can cause abrasion of the equipment.

Material hardness

Understanding the concept of material hardness is crucial in addressing this issue. The Mohs hardness scale serves as a simple yet effective method for measuring material hardness. Essentially, the higher the Mohs number, the harder the material. With 10 levels, the scale positions diamond as the hardest material at level 10 and talc at level 1. Harder materials cause abrasion or scratches on softer ones.

In the context of pneumatic transfer

systems, regular pipes are commonly made of ordinary steel (Mohs hardness 4-5). Given that most biomass contains silica, which at Mohs hardness 7 has a higher hardness level than steel, conveying biomass through a pneumatic system can result in abrasion and premature wear of steel pipes. According to past data, using standard steel conveyor pipes often results in leakage issues within a month of installation, depending on the volume of biomass fuel being fed into the system.

Consequently, it becomes evident that ordinary steel pipes are ill-suited for the AF pneumatic transport system.

Preventing the need for repair

Both leakage and abrasion cause significant instability in the fuel feeding system. Repairing the transport and fuel feeding system often requires halting machinery operations, adding a direct burden on the maintenance team.

Moreover, if the damaged area is located at height, repairs become even more challenging, often requiring scaffolding or lift trucks, which introduces risks associated with working at heights.

Various approaches have been experimented with to address the abrasion and leakage problem, such as using abrasion-resistant steel, wear-resistant welding rods (cemented carbide), wear-resistant ceramics and wear-resistant castables. Each type of material has its own appropriate applications depending on the area of use. For solid fuel conveying pipes, it was found that the most effective liner is a wear-resistant ceramic used as an inner lining for the pipes. A key property of this material is its exceptionally high hardness – nine on the Mohs hardness scale, second only to diamond.

Moreover, despite its high hardness, its density is less than half that of steel, which directly impacts the structure’s weight, allowing it to be installed as a replacement without the need to reinforce the existing structure. When correctly installed and utilised, the longevity of this material can surpass that of traditional steel pipes by five to 10 times, devoid of any leakage issues. In addition to being used in conveying pipes, this material can also be applied in areas exposed to severe abrasive dust, such as vertical mills, cyclone separators and other similar applications.

Therefore, to enhance the clinker production process in a more environmentally friendly way, continuous and relentless improvements are essential. Beyond the kiln, the non-kiln areas should not be overlooked. Focussing on these areas is crucial for achieving the net-zero target in the near future. ■

Figure 6: results of applying a wear resistance solution

