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Trash into treasure: using waste to fuel greener construction

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Global Segment Manager at Malvern Panalytical, Murielle Goubard, discusses how the building materials industry can contribute towards a greener future.

The United Nations estimates that the global population will reach approximately 9.7 billion people by the year 2050. This raises concerns about the amount of waste such a vast number of people is expected to produce.

The growing population will lead to a greater demand for housing and infrastructure, which will require more concrete and cement. There is concern that the necessary increase in construction using these materials may have a detrimental impact on the environment.

Impact on the industry

The cement industry produces the majority of its carbon dioxide (CO_2) emissions through two processes:

- Combustion of fuels to heat the kilns.
- Calcination of limestone, the principal calcium carbonate raw material.

In the production of ordinary portland cement (OPC) with 95% clinker, 38% of CO_2 emissions per ton of produced cement comes from the utilisation of fossil fuels for heating the rotary kiln. Strategies must be designed to reduce the energy consumption and emissions associated with this process.

Is waste the solution?

Fortunately, researchers are already producing solutions to the waste problem. It has been projected that waste production will increase by 70% by 2050, primarily due to the increasing population. Whilst this is potentially a significant issue, it could be transformed into an opportunity. Utilising waste as a substitute source of fuel could be the answer.

The cement industry has already implemented the use of alternative fuels. The substitution of fossil fuels with fuels derived from waste materials has resulted in a significant drop in emissions.

Burning waste as a fuel source is beneficial for both communities and manufacturers, as it transforms waste into a productive resource, eliminating the need for costly disposal or storage. Using pre-existing infrastructure conserves further resources, as the heat generated from incineration is harnessed as useful energy, rather than being wasted in a municipal plant.

Manufacturers also benefit from this method. Substituting pricey fossil fuels with a readily available resource that people are eager to dispose of is cost-saving for businesses.

Supporting the shift

However, there is an issue with this approach.

Alternative fuels derived from waste materials tend to vary significantly in terms of the materials they're composed of. On top of this, they also may have different levels of moisture and varied distributions of particle size. Some of these fuels can even contain toxic elements such as mercury, thallium, or cadmium. These elements can potentially cause illegal or harmful emissions.

Some other elements like Chlorine and Sulfur for instance could also have adverse effects on the cement properties and on the process itself. Finally, these variations can also modify the temperature and atmosphere in the rotary kilns, leading potentially to heterogeneous and inappropriate clinker.

However, this does not imply that these fuels should not be used. Instead, meticulous control protocols should be employed. This will ensure a stable fuel stream, guarantee safety, prevent environmental harm and make sure to get the targeted clinker, leading to the cement with the right composition and properties.

The most effective approach to controlling the fuel stream and monitoring its composition is through materials analysis. Ideally, this analysis should be fast and accurate to facilitate efficient operations and maximise value.

Equipping yourself with the right tools

X-ray fluorescence (XRF) is a prominent technique for precise and consistent elemental characterisation, and it can be effectively combined with other methods.

Standardless analysis program software can also be used to quantify elements when no matrix-specific

standards are available. This is especially useful for alternative fuel applications, where samples may be inconsistent or even unidentified.

XRF Instruments like the Epsilon 4 and the Zetium answer this challenge, while cross-belt analysers like the PFTNA CNA Pentos allows to continuous elemental characterization and monitoring of the process, with real-time measurements and related (re)actions.

Green cement: a solution for a cleaner world

It’s clear that the future presents a multitude of challenges and opportunities for us all, particularly in the building materials industry. However, by employing intelligent solutions and pioneering tools, we’re capable of constructing the future world and enhancing its environmental sustainability.