POSITION PAPER

HOW CARBONISATION ENABLES THE SHIFT FROM ENERGY TRANSITION TO THE MATERIAL TRANSITION

Perpetual Next Dilsen
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CONTEXT OF THE PAPER

This short position paper is part of several articles that discuss the carbonisation of low-value bio-residual flows for replacement of fossil carbon.

THE ENERGY TRANSITION

Nowadays it is widely accepted that the era of fossil carbon must end and therefore an important and urgent transition to a fossil-free industry needs to take place. Carbonised solids are perhaps the most known intermediate bioenergy carriers (IBC's) for the general public. Although the diversity of possible applications for the carbonised solids underwent an evolution, the image of carbonised solids (biocoal) is still heavily linked to electricity production. The explanation has to do with the history of carbonisation.

Carbonised solids as a sustainable solution for industrial electricity production

After the Kyoto Protocol (1997), the carbonisation industry emerged gradually with independent private and corporate stakeholders. Although several industries were in search for sustainable fuels, the market demand for a sustainable coal replacement was most visible with the electricity producers. They used fossil coal at the largest visible scale. Because biomass was defined as sustainable by the UN, and co-firing of biomass had technical limitations, carbonisation technologies were developed to transform biomass into sustainable coal: widely called '(biocoal'.

After a promising start of the development of several carbonisation technologies, following reasons suddenly slowed down or stopped all carbonisation related projects: The 2008 economic recession, which paused or ended subsidies regarding sustainability. Which also caused
a drop in fossil coal prices. And (due to full stop of the construction industry and the stop of the needed timber) caused a raise in prices of scarcely available woody biomass residuals. Feedstock became too expensive for carbonisation. And fossil coal became too cheap to compete with. Under those conditions, carbonisation was not economically feasible.
At the same time, the demand for a full replacement of fossil coal to produce electricity had a mismatch with the carbonisation industry's ability to supply the quantities of suitable biocoal. As a result, coal fired powerplants either were converted into biomass fueled powerplants, or were decommissioned completely and replaced with solar-, wind- or hydro powered electricity production. Also, nuclear power is in some nations still considered as a viable 'zero emission' option.

The historic negative media attention regarding fossil electricity production and the use of all alternative fuels that came into play, influenced the public opinion. To this day, existing coal fired powerplants are still subject to debate. Alternative fuel sources, including carbonised solids (biocoal.) are therefore still commonly associated with 'electric power generation'.

Carbonised solids as a sustainable solution for industrial power and heat production

Over time, the carbonisation technology has reached a mature state. The demand of the electricity producers meanwhile shifted to the background. But other industries have expressed their increased demand for biocoal. These currently fossil fuel users, have a need for industrial power and heat. Driven by economic, legal or social drivers, they search for suitable, sustainable fossil alternatives. The final objective is often an electric 'zero emission' replacement to the fossil original process. But this is either not always possible, or the technology is still under development. The biocoal can help to a final non-fossil solution. Or it can satisfy the short-term sustainability demand in the transition to electrify and replace the original (fossil) power and heat application.

The biggest power and heat industries are the steel industry and cement & lime industry.

Somewhat smaller power and heat industries are the paper industry and the road construction (asphalt industry).

Biocoal for use in industrial power and heat applications is a more viable solution than for electrical power generation. There is more match between the need of the industries and the realistic capability of supplying carbonisation industry to satisfy the demand in terms of scale size. Furthermore, an important difference with electricity production is the fact that industrial power and heat is part of the process that generates tangible products. Energy is not the product itself. This positively influences economic (and social) support.

THE MATERIAL TRANSITION

Thus far the obvious applications show the need for carbonised solids with an emphasis on energy content. Biocoal is seen as the sustainable replacement of fossil coal. Indeed, society has had a focus for energy transition (fossil energy to non-fossil energy). However we gradually see an increased desire to replace fossil natural resources needed for production of goods and materials. There are numerous applications that need carbon atoms. This means that carbonised solids are no longer only related to fuel or energy. The term 'biocoal' does therefore no longer cover the full understanding of carbonised solids. This advanced insight explains the introduction of the term **"biocarbon"**.

Biocarbon can be utilised as a ready-to-use material for applications to create products. Biocarbon improves the product properties and at the same time preserves carbon atoms (carbon sink). The known applications are for composites in: construction, agriculture and plastic industry (fillers and fibers).

Because of its homogeneous quality nature, biocarbon can also be used to supply the chemical industry, which cannot direct access the carbon of the heterogeneous bio-residuals. Biocarbon can act as a raw material for: bio-refinery, pyrolysis (liquid), gasification and steel industry (as alternative to fossil carbon reducing agents).

For all those applications, biocarbon can be delivered as flakes/chips (without crushing or grinding), powder or in a densified form (pellets, briquettes...), depending on the requirements.

All applications that use bio-residuals will eventually be subjected to the so called 'cascading principle'. The need for a circular economy leads naturally to maximization of resource effectiveness by using bio-carbon in products that create the most economic value over multiple lifetimes. The envisioned consequence for biocarbon is the priority use of bio-carbon to make products of a higher added value, which are then reused or recycled, and not used in energy production until the end of its natural lifecycle. Already the carbonisation industry acknow-ledges a growing conscience in society, evolving legislation and economic enablers (subsidies) and disablers (taxes) that eventually will regulate access to available feedstocks.

With carbonisation, biocarbon can be produced not only for usage as an energy carrier, but also to exploit the carbon atoms themselves. Heterogeneous low value bio-residuals can be carbonised into homogeneous carbon dense quality streams. Carbonisation is no longer limited as a solution to aid energy transition, but to replace fossil resources to produce goods and materials that are dependent on the carbon atom itself. With this new insight carbonisation therefor aids to the material transition: the shift from fossil to non-fossil resources that enables the creation of tangible goods.