Summary Series

Status overview of torrefaction technologies

A review on the status of the commercialisation of biomass torrefaction

IEA Bioenergy

IEA Bioenergy: Task 32: 2015

Status overview of torrefaction technologies

A review on the status of the commercialisation of biomass torrefaction

Jaap Koppejan, Marcel Cremers, Jan Middelkamp, Joop Witkamp, Shahab Sokhansanj, Staffan Melin, Sebnem Madrali

Summary

The maturation and market introduction of torrefaction technologies has gone slower than anticipated in 2012, when it was expected that a significant fraction of the biomass pellets supplied today could have been replaced by torrefied pellets. It has been hard to fully prove the claims made earlier on product characteristics, and several companies have gone bankrupt due to inability to produce good quality product or due to a lack of buyers.

As of 2015 however, some important progress can be observed. The torrefaction technology has been proven on pilot scale and a number of demonstration and (semi)commercial facilities have been realized. The companies involved have significantly improved their ability to produce high quality products, with pellets of comparable durability to conventional wood pellets. The torrefied pellets exhibit comparable supply costs, however, for the end user it provides superior handling and combustion characteristics. Total cumulative production figures are estimated at 70-120 ktons of torrefied product to date. The product has been used in coal plants, gasifier(s) and non-industrial facilities, although in very few cases for an extended period of time. Some developers, however, have re-focused on the market for torrefied material: they consider smaller domestic or industrial markets more promising than large scale utilities.

As for wood pellets, price parity with coal is essential to enable commercial market introduction of torrefied biomass for co-firing. In the absence of a substantial price penalty for CO_2 emissions and with the low price level of coal, this implies that additional support schemes should be in place.

The full report is available at
http://www.ieabcc.nl/publications/IEA_Bioenergy_T32_Torrefaction_update_2015b.pdf

Conclusions

RECENT TECHNOLOGY DEVELOPMENT

In recent years, the companies involved in torrefaction have significantly improved their ability to produce high quality products, with pellets of comparable durability to conventional wood pellets. The most important technical challenges in the development of torrefaction processes relate to achieving constant and well controlled product quality, scaling up the process and product densification. Most progress has been made on the ability to densify the material to a durable pellet or briquette which can be handled without generation of large amounts of highly explosive dust, although few developers have produced significant amounts (>10 ktons) of torrefied pellets or briquettes yet. Although demonstration and (semi)commercial facilities are running now, finding the optimal process conditions for producing a stable and high quality end-product are ongoing.

Torrefaction of agro-residues appears to be more complicated than wood due to the challenging physical and chemical characteristics. This would only make it feasible to develop suitable torrefaction processes in case significantly lower prices for the input material can be secured. So far, the developments on using agro-residues are limited.

There are still a few dozen of torrefaction developers, although the ones with a (semi)commercial facility with a production capacity of some ten-thousands of tons per year are less than 10. Some developers have become less active in the field (sleeping), whereas there are also new entrants. A number of realization projects are in the pipeline, typically ranging up to 250,000 tons per year production capacity.

THE BUSINESS CASE

Depending on production location - EU or Canada/US, resource supply distance, torrefaction plant size, product distribution distance in Europe and scale of the end user - the costs of delivery vary between 10 and 17 Euro per GJ, which is comparable to white pellets. In general one can say that for longer transportation distances, the additional costs of the torrefaction process can be compensated by savings in transportation costs.

The similarity to coal should enable higher co-firing percentages for torrefied pellets as compared to regular wood pellets (or even complete fuel switching), without significant modifications to a power plant. However, as the actual market price of torrefied pellets is not determined by the production cost, but by product substitution value, including perceived risks, this does not result in a higher market price. With low prices for coal and CO_2 penalties, and a high perceived risk, there is limited willingness to pay reasonable prices for torrefied pellets. Only if significant commercial production starts up and trade volumes increase a true market value of torrefied pellets or briquettes will be established.

In the past few years the (commercial) position of torrefied biomass against white wood pellets for application in large scale power plants has not improved. White wood pellet application in large power plants has achieved significant volumes and facilities that enable the use of white wood pellets are meanwhile considered proven technology. Further it is important to realize that there is only a real benefit if the associated investments for modifying a plant to enable the use of wood pellets can be avoided.

Moreover, the pressure on fuel costs in the power industry is huge. As a result, some developers are re-focusing on smaller scale applications for torrefied biomass. For these domestic or small industrial scale applications current fuel price levels may be more attractive to introduce torrefied biomass. In addition, these applications require smaller torrefaction plant capacities, making discussions with financers easier.

POLITICAL AND LEGISLATIVE CONSTRAINTS

Price parity with coal is essential to enable commercial market introduction of torrefied biomass for cofiring. The relatively low CO_2 price is however a major hurdle for the business case, as the CO_2 penalty alone is insufficient to switch from coal to torrefied biomass. It is important that CO_2 emission allowances are tightened in order to increase CO_2 prices, and that additional support schemes are put into place by individual EU member countries to facilitate cofiring of (torrefied) biomass. Further, torrefied biomass needs to be accepted within regulatory frameworks. Currently, no clarity exists on fiscal subsidy schemes for torrefied biomass. The question is how it will be treated by governments and regulatory frameworks.

IEA BIOENERGY

The IEA Bioenergy Technology Collaboration Programme (www.ieabioenergy.com) is a global government-to-government collaboration on research in bioenergy, which functions within a framework created by the International Energy Agency (IEA - www.iea.org). As of the 1st January 2016, 23 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the USA, and the European Commission.

The mission of IEA Bioenergy is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. The Agreement provides platforms for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis with a focus on overcoming the environmental, institutional, technological, social, and market barriers to the near- and long-term deployment of bioenergy technologies.

Further Information

IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/