Biomass Pre-treatment Technologies

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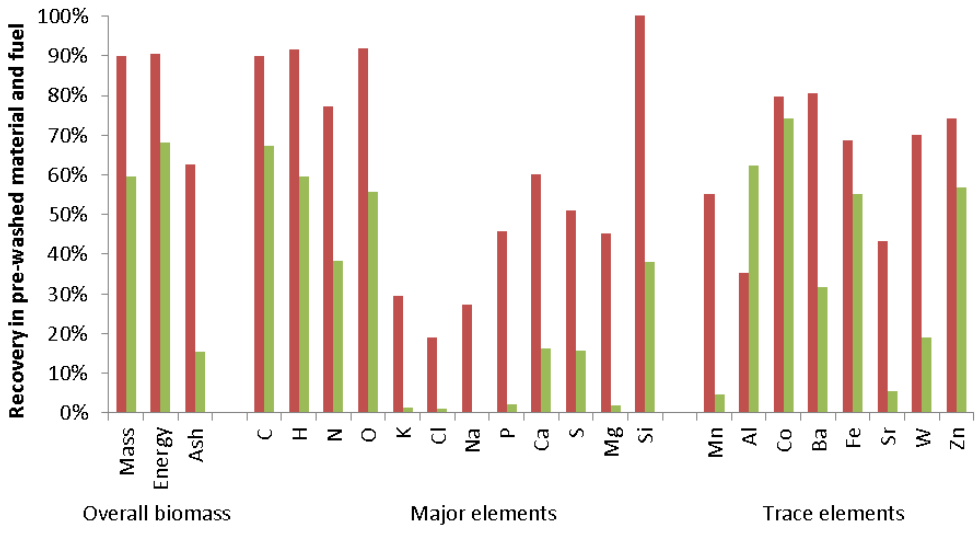
TORWASH and Torrefaction are pre-treatment technologies that can improve the supply chain of biomass by increasing the volumetric energy content of the fuel, and improving its fuel characteristics. This leads to the production of high-quality sustainable solid bioenergy carriers. In addition, TORWASH can reduce the salt content of biomass.

TORWASH

TORWASH is a technology that is under development at ECN for the conversion of herbaceous biomass into an attractive solid bioenergy carrier. The feedstock for TORWASH often combines three undesirable characteristics: 1) high moisture content, 2) containing too much salt, and 3) being difficult to comminute and bulky. Herbaceous biomass is typically not suitable for direct utilisation as fuel for combustion or gasification. These fuels display an increased moisture content that corresponds to lower net calorific values, while the increased salt concentration – in particular potassium and chloride – can cause problems such as corrosion, agglomeration, slagging and fouling upon thermal conversion. Furthermore herbaceous biomass can result in issues during size reduction due to its flexible nature. Lastly, the bulky nature and the high moisture content result in relatively expensive logistics costs. By using TORWASH, all of these undesirable characteristics are drastically improved. The product of TORWASH is a solid bioenergy carrier with characteristics equal to those of torrefied wood pellets. Within the LogistEC project Arundo Donax Giant Reed was successfully subjected to batch TORWASH experiments. The recovery rates during the pre-wash and TORWASH step are displayed in Figure 1.



Arundo Donax

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TORREFACTION

Torrefaction is a thermochemical process that has its roots in the roasting of coffee beans and gives coffee its characteristic flavour. For biomass, it is used as a pre-treatment process in the typical range between 250-300°C in order to upgrade the biomass and convert it into a high-value solid bioenergy carrier. The chemistry behind torrefaction involves mainly the removal of oxygen from the biomass structure after exposure to a hot, inert atmosphere. This causes the biomass to transform into a hydrophobic, homogeneous and dense solid energy carrier, which typically contains about 70% of the mass and 90% of the energy initially present in the biomass. Torrefaction side-products are vapours and gases which can be combusted to generate process heat, creating a self-sustaining overall process. The torrefied product can be further processed into densified pellets or briquettes obtaining a high-quality product adjusted to logistics and end-use requirements.

Chipped Willow and Triticale pellets were successfully torrefied at the ECN pilot torrefaction plant with a throughput of approximately 50 kg/h. It should be noted that torrefaction, unlike TORWASH, does not typically result in ash removal; the volatilisation of some organic matter normally results in a slight increase of the ash content. The torrefied Willow was successfully briquetted by CF Nielsen, although briquetting of pre-compacted materials proved to be more difficult. The pre-pelleted torrefied Triticale was successfully densified in ECN's lab-scale pellet mill, as displayed in Figure 3. This figure indicates that the volumetric energy density of bulky biomass streams can be significantly increased through torrefaction and densification.

Willow

Willow

Triticale

Triticale

For more information contact Michiel Carbo - Energy Research Centre of the Netherlands.

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