TECHNICAL PAPER

TORREFACTION OF LOW VALUE BIOMASS CONTAINING RESIDUAL FLOWS

An overview of the challenges, which have to be resolved using these kinds of feedstock.

TorrCoal Technology B.V.
Jo Sluijsmans, BSc
Manager R&D / QHSE

ABSTRACT
When using low value biomass containing residual flows as feedstock for the torrefaction process the increased chlorine and sulphur content of these flows will be the main problem. After torrrefaction chlorine and sulphur will be partly present in the process Torr-gas and partly in the product to the extent that it will give rise to emission to open air and corrosion problems.

Three technical papers have been prepared on flue gas cleaning, torrefied product cleaning (desalting by washing) and purification of the washing water.

CONTEXT OF THE PAPER
This technical paper is part of a number of articles that describe the use of low-value biomass-containing residual flows as a raw material for the torrefaction process, whereby the torrefied product (BioCarbon) should treplace fossil black and brown coal in various types of application.

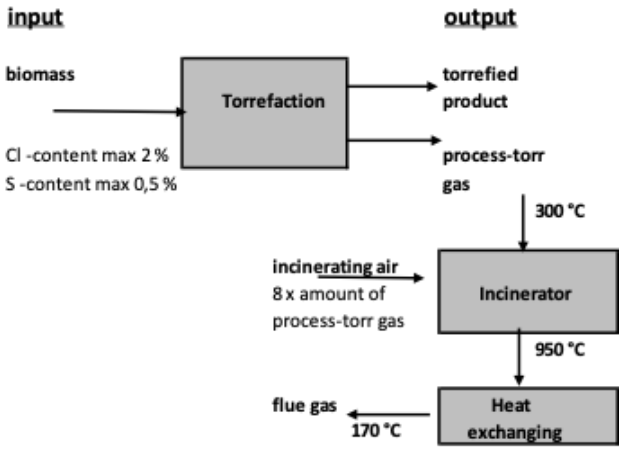
TORRCOAL

TORREFACTION OF BIOMASS CONTAINING LOW-VALUE RESIDUAL FLOWS

Exposing various biomass containing flows to a torrefaction process (heating up to 300 °C in an oxygen low environment), the properties of these flows will be changing in such a way these can be used as a fossil coal substitute for energy production and chemical industrial processes (like syngas production and steel production).

For business economic and sustainable reasons biomass containing flows are used, which cannot be used in their original form for other high-quality applications.

Unfortunately, these biomass containing flows mostly show an increased chlorine content (max. 2 w.-%) and / or sulphur content (max. 0,5 w.-%). During torrefaction the containing chlorine and sulphur move partly to the process-torr gas and partly these elements stay behind in the torrefied product.



Distribution Cl and S: input to output

	torrefied product		process-torr gas	
	min.	max.	min.	max.
Cl	10%	50%	50%	90%
S	40%	80%	20%	20%

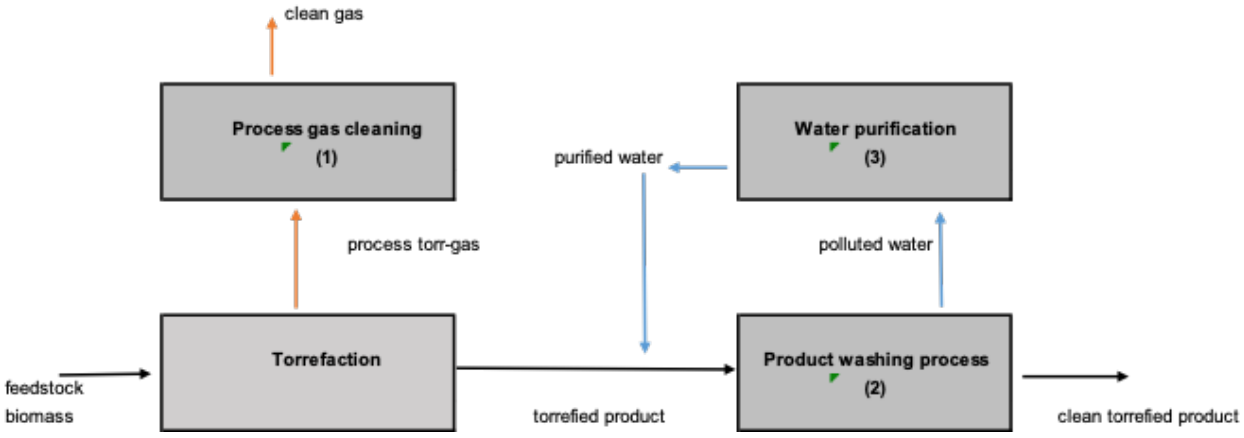
The process-torr gas is burned during the torrefaction process and flue gas will come into existence with HCl and SO2 content far above the allowed emission standard to open air.

The solid product will show such an amount of chlorine and sulphur, that it can lead to problems for the customer (corrosion; exceeding emission standard), if it will be used as a fossil coal substitute.

To meet the prescribed emission standards it is necessary to remove sufficiently chlorine and sulphur from the process-torr gas or the flue gas before emission to open air takes place (process-torr gas or flue gas cleaning)

Next it make sense to remove on request of the customer as much as possible chlorine and sulphur from the solid product (product cleaning; desalination). Chlorine and sulphur, present in the torrefied product, are bounded to a great extent inorganically (anion: Cl(-); anion sulphate: SO4(2-)). This would mean, that this chlorine and sulphur can be removed from the product by washing with water (product washing process).

Due to the fact large amount of washing water is used for this desalination process it makes sense for economic and environmental reasons to reuse this water. The washing water used is contaminated with soluble salts, organic compounds and very small particles torrefied material and must be purified before reusing it (water purification).



Technical paper "Flue gas cleaning during the torrefaction process" describes the method which is used to clean the gasses before emission to open air and stipulates why this method has been chosen. This gas cleaning system has been installed at the industrial torrefaction production installation in Dilsen-Stokkem (Belgium) end 2020. By doing that it was possible to meet the prescribed emission standards, in case biomass containing low-value residual flows with increased chlorine and sulphur content are used for torrefaction on industrial scale.

Technical paper "Product cleaning (desalination) after torrefaction" describes the tests done on laboratory scale and the results of these tests concerning the cleaning (washing) of the product.

Next to that the results of the basic engineering (including mass balance and energy consumption) of this washing process on industrial scale are mentioned. This basic engineering and relevant tests were carried out in collaboration with potential suppliers of the necessary equipment for this washing process. Detail engineering and installing a pilot test installation for the purpose of this process have not been carried so far.

Technical paper "Reuse of contaminated washing water" describes the possible composition of the polluted washing water.

Next to that the results of the basic engineering (including mass balance and energy consumption) of this water purification process on industrial scale are mentioned. This basic engineering and relevant tests were carried out in collaboration with potential suppliers of the necessary equipment for this process. Detail engineering and installing a pilot test installation for the purpose of this process have not been carried out so far.

CONCLUSION

Low value biomass containing rest streams, like agricultural residues, wood from park and forest maintenance (branches), demolition wood and separated household waste (SRF), can be used as a raw material for the torrefaction process, whereby the torrefied product (BioCarbon) could replace fossil black and brown coal in various types of application.

Some of these raw materials will show an increased chlorine and sulphur content and that is why that next to torrefaction additional processes are needed to meet the prescribed emission to open air standards and to avoid unacceptable corrosive behaviour of the process gas and torrefied product on the process equipment.

Cleaning of the process gas will mean a gas cleaning is needed. To clean the torrefied product a washing process is needed and by that also a water purification process for the contaminated wash water is recommended for economic and environmental reasons.

Three technical papers have been prepared on flue gas cleaning, torrefied product cleaning (desalination by washing) and further purification of the washing water.