D 2.4 Implementation and optimization of the CHGP technology for bulky waste

Executive summary

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Number and name of deliverable: D 2.4 Implementation and optimization of the CHGP technology for bulky waste

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1. Objective

The deliverable D2.4 aims at providing a detailed presentation of how the catalytic hydro-gasification with plasma technology works with urban bulky waste streams, mainly mixed hard plastics and wood together with other non-valuable fractions.

The main objective is the production of Poly-Methylal, as a technical grade multifunctional chemical product or an additive for fuels, through a catalytic hydro-gasification with plasma technology mainly for mixed hard plastics and wood and other non-valuables fractions, with a reaction yield of 60% with a purity of at least 90% of Methylal and final costs saving of at least 30% in comparison with petrol based products.

2. Actions done

The bulky waste is characterized by being very heterogeneous both chemically and physically, which makes its recovery very difficult and economically not viable with current technologies. As a direct consequence, most of the bulky waste is landfilled or used for energy recovery.

BPP's technology has been selected to demonstrate its effectiveness for urban bulky waste chemical recovery. The plant technology is based on plasma-hydro-catalytic gasification technology working in a continuous process as part of the BPP Biorefinery to produce Poly Methylal.

The pilot plant consists of two main units:

- The Gasification Unit, where the non-recyclable bulky waste fraction is converted into a syngas.
- The Liquid Methylal Production Unit, where the generated syngas is converted into a liquid fuel´s additive.

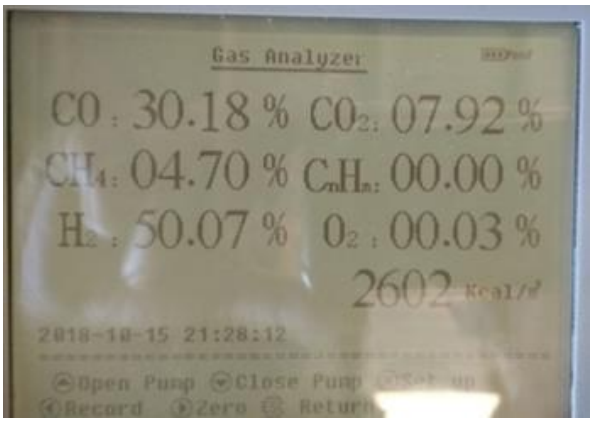
Pilot plant view is shown below:

The bulky waste received from URBANREC project partners has been first analysed physically and then feeding tests have been carried out. As a result of these tests some of these residues have been used as received while others have been densified to reach an

appropriate density. The composition of mixture of bulky waste streams chosen to make the gasification tests is shown below.

Material	Note	Density (g/L)	% Mix	Mix Density
Pellets 1	75% Plastic; 25% Textil	343	25%	86
Pellets 2	50% Wood, 25% Artificial grass; 25% Textil	300	40%	120
Latex Foam		57	5%	3
Tire Rubber		423	30%	127
			100%	335

The gasification tests performed with this bulky waste mixture resulted in the syngas shown in the photo below.



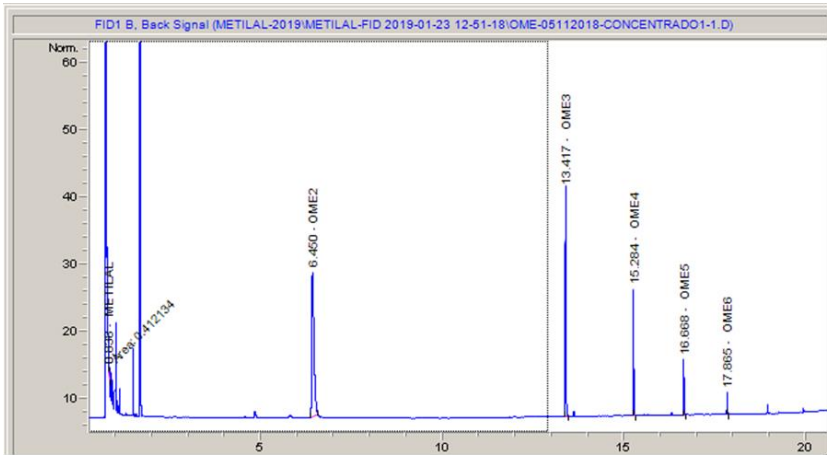
Due to the experiences of these gasification tests, some adjustments have been made to the initial Gasifier design, in order to improve the efficiency of the gasification process. To sum up:

- The hydrogen content remains at 50% average values by regulating the amount of water together with the plasma power system.
- Drastic reduction of methane and other short-chain hydrocarbons content, favouring the increase of hydrogen and carbon monoxide.
- The molar ratio of Hydrogen and carbon monoxide remains at optimal values for the Poly Methylal synthesis process.

As a side effect of the adjustment done on the gasification process, water is generated in the subsequent syngas cooling stage. This water is first stored and then used in mixtures with the bulky waste fractions that will be gasified in the next trials.

Due to chemical composition of the bulky waste used, some ashes/minerals are left from the gasification process as residues accompanied by some carbon powder. In order to reduce the carbon portion, these residues can be reprocessed in the same gasification process or can be treated at high temperature with the plasma system and the carbon monoxide realised is gone as part of the synthesis gas. As a result of this last treatment, minerals can be used in the construction sector.

Once corrective actions were performed on some component of the Liquid Methylal Production Unit, reactors were filled with their respective catalysts, and then tests of Poly-Methylal production were carried out. The result of these tests is shown below and is being analyzed to find out the quality of the resulting product.



Products Chromatography

Poly-Methylal obtained

3. Conclusion

To sum up, the main conclusions of the construction and testing works carried out in the pilot plant are described below:

- The bulky waste volatile fraction has been reduced by more than 85%.
- The ashes/minerals that resulted from the gasification process as residues represent an average of 23% of the initial weight of the bulky waste treated, which means a weight reduction of 77%. In terms of volume, the reduction is close to 90% compared to the initial volume.
- The current yield obtained in the pilot plant is about 0,3 litres of final product per kg of bulky waste processed. This value can be increased up to 0,5 litres per kg of waste by optimizing the pilot plant working parameters and by using the unreacted gases that actually are burned in the safety torch.
- The by-product water is used in the gasification process, mixed with the bulky waste fractions.
- The unreacted gases from Poly Methylal synthesis process combusted in the safety burner comply with the environmental regulation limits.
- In the industrial plant we can expect a great reduction close to 90 % on the electric consumption of the pilot plant if the adequate size and power selection of the individual components is applied.