Molecular characterization of new renewable feedstocks by multi-scale analysis using GC, MS and an oxygen selective detector

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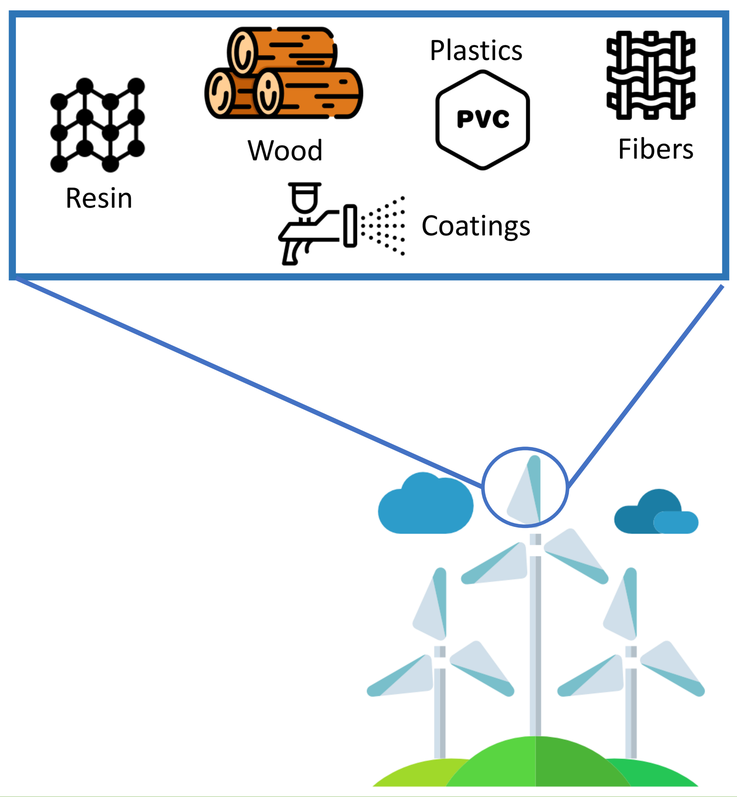
Context

It is estimated that **43 million tonnes** of waste will be generated from **wind turbine blades** by 2050, making them a priority for recycling [1]. As most parts of wind turbines are made of concrete and steel, their recyclability is straightforward. However, other components, such as wind turbine blades, are highly **complex assemblies** [2]. These heterogeneous assemblies make them difficult to recycle and require different processes to recover valuable products. Mechanical recycling, solvolysis and thermal recovery are the three approaches currently used to treat used wind turbine blades in order to **limit** their disposal to **landfill**. However, solvolysis and mechanical recycling have **limitations** that prevent them from being used on an industrial scale. Pyrolysis, on the other hand, has many advantages that make this approach more **suitable for industrial use**.

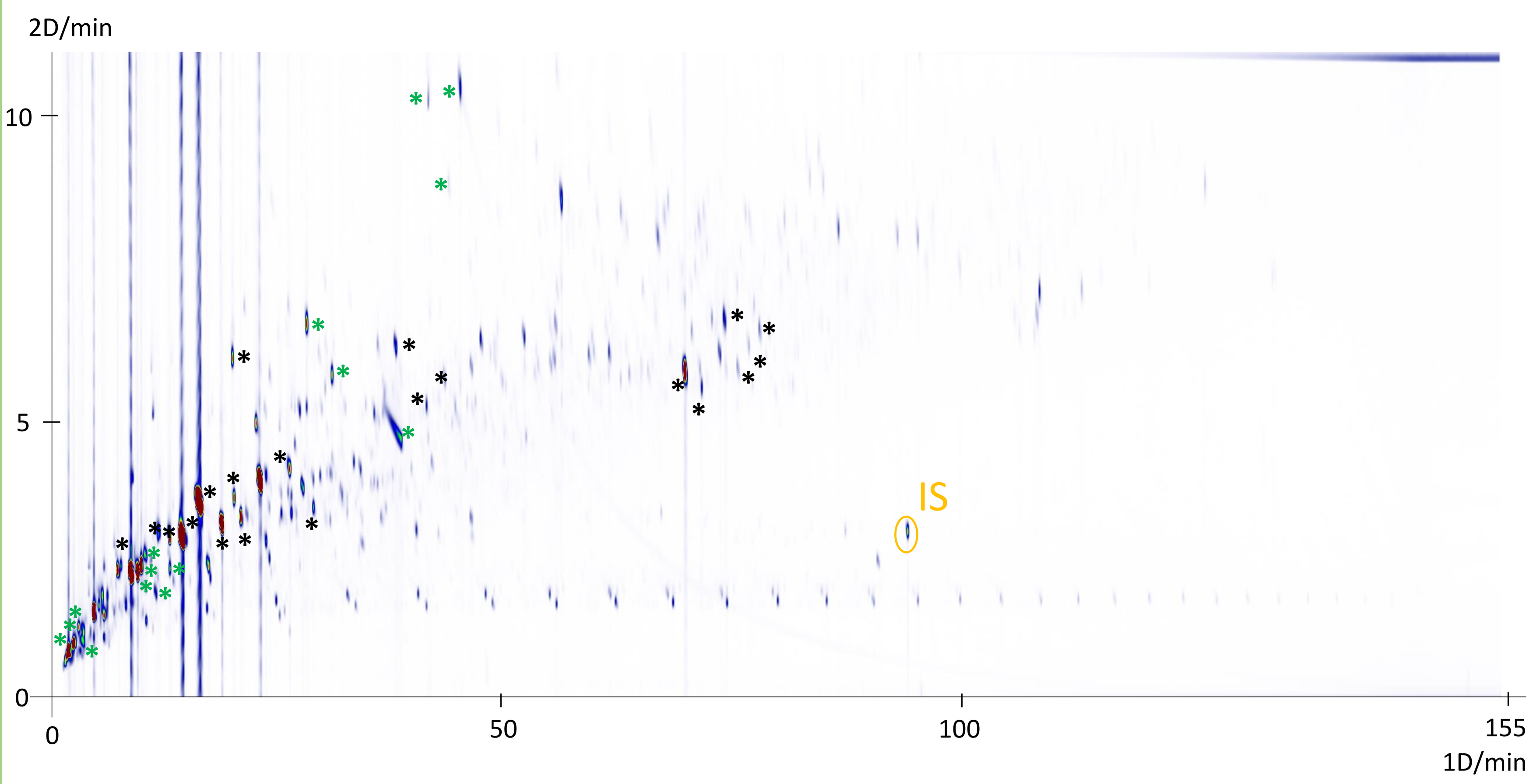
The **availability** of used wind turbine blades and the interest in recovering their components has made the development of a large-scale recycling process a priority. However, understanding their molecular composition is of paramount importance in order to produce a valuable product.

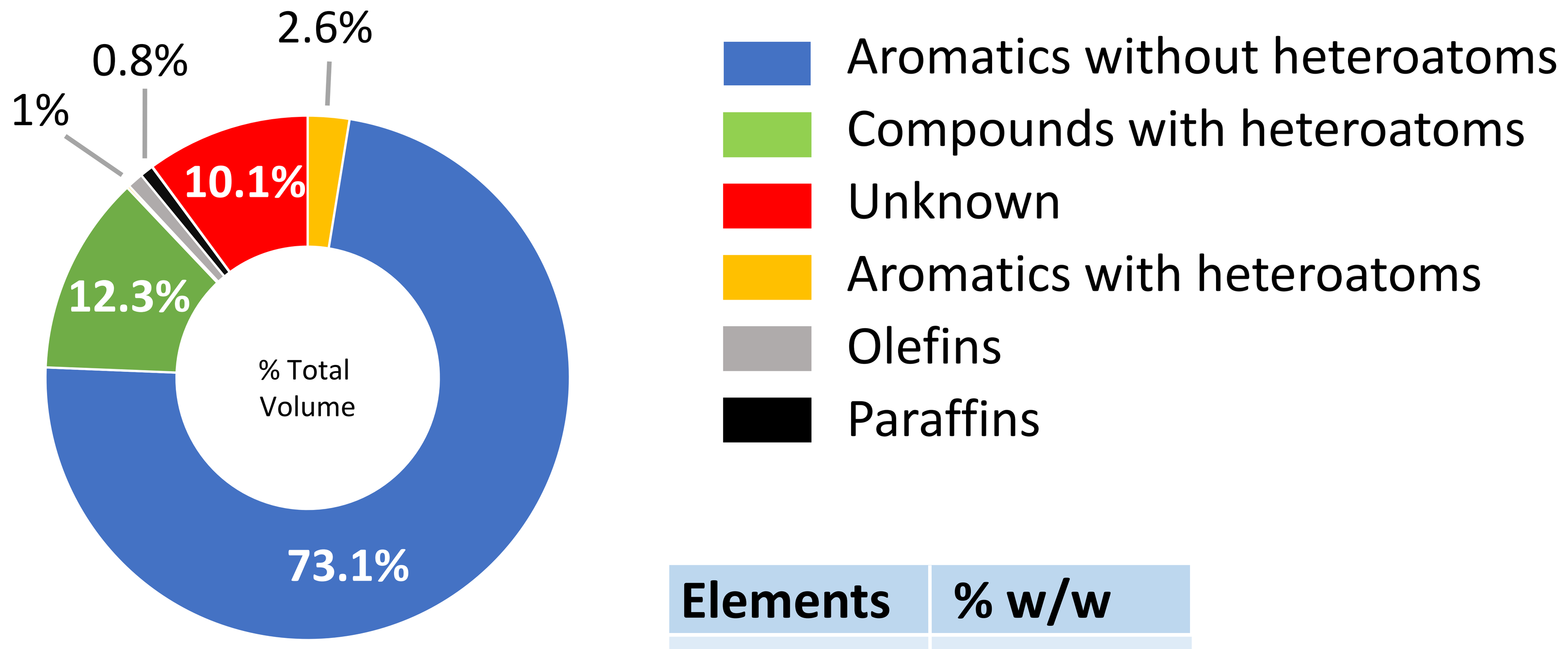


Workflow

Results

GC×GC-FID



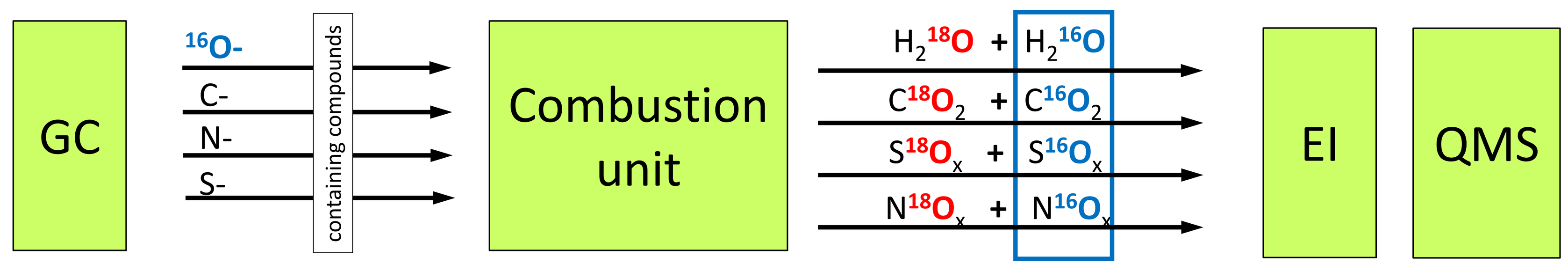


Elements	% w/w
C	81.1%
H	8.8%
N	< 0.3%
S	< 0.5%
O	10%

Elemental analysis

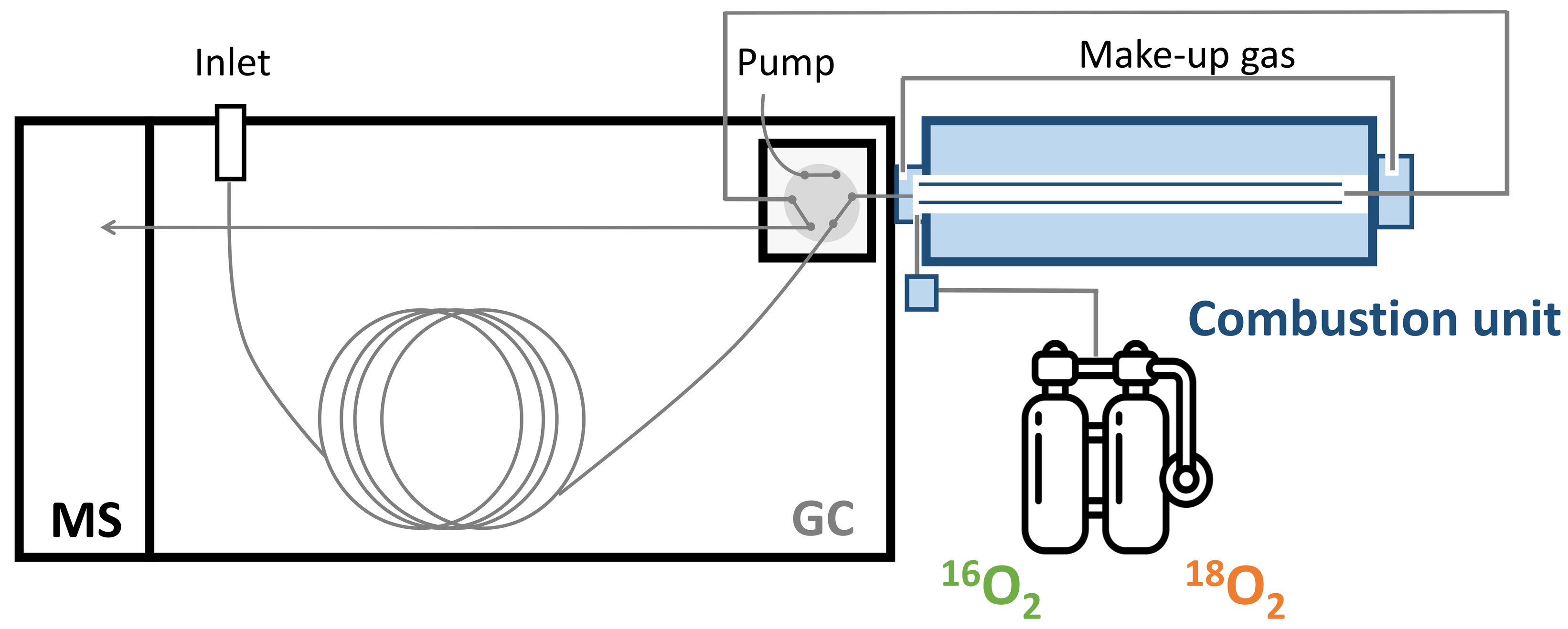
Perspectives

$$C_aH_bO_c + \left(a + {}^{b}/_{4} - {}^{c}/_{2}\right)O_2 \xrightarrow{850°C} aCO_2 + {}^{b}/_{2}\,H_2O$$



The detection and quantification of C, N and S containing compounds using $^{16}O_2$ **gas** are achieved by following the m/z of their volatile combustion species: 44, 30, 64.

The characterization of oxygenated compounds using $^{18}O_2$ **gas** is done using m/z 16, thanks to in source - combustion gas fragmentation



Accurate – Equimolar – Selective – Sensitive – Robust

The instrument is available from **Shimadzu** under the name of **ELEM-SPOT**

References

[1] Liu, Pu, and Claire Y. Barlow. "Wind turbine blade waste in 2050." *Waste Management* 62 (2017): 229-240.

[2] Yang, Wooyoung, Ki-Hyun Kim, and Jechan Lee. "Upcycling of decommissioned wind turbine blades through pyrolysis." *Journal of Cleaner Production* 376 (2022): 134292.

Conclusion

The use of elemental analysis and **GC×GC-FID/QTOFMS** allowed us to elucidate the general molecular composition of the pyrolysis oil from **wind turbine blades**. These methods highlighted the presence of a significant amount of **oxygenated compounds**. Since the understanding of the heteroatomic composition of the pyrolysis oil is necessary for the valorisation of the final product, the use of an ultrasensitive multidetector (**ELEM-SPOT**) is essential and the main perspective of this work.