# Neural networks to obtain synthetic petroleum

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The UPV/EHU's Catalytic Processes for Waste Valorisation research group is working on a project related to obtaining bio-oils or synthetic petroleum using biomass. In a paper recently published in the scientific journal *Fuel*, the researchers have proposed using artificial neural networks to determine the heating power of each type of biomass based on its composition.

Biomass is one of the main sources of energy and heat in the field of renewable energy production. It comprises any type of non-fossil organic matter, such as living plants, timber, agricultural and livestock waste, wastewater, solid urban organic waste, etc. The three most advanced technologies for obtaining energy from biomass are pyrolysis (decomposition by heating in the absence of oxygen), gasification (reaction with air, oxygen or a blend of both and conversion into gas) and combustion (decomposition through heating with oxygen). The effectiveness and emission levels of these three processes vary depending on the composition of the biomass as well as its properties, the experimental conditions and equipment used.

In collaboration with researchers at the University of Sao Carlos in Brazil and within the framework of a European project, members of the research group analysed the process to refine bio-oils or synthetic petroleum using biomass. "Afterwards, using the bio-oil produced, it is possible to obtain the same products that are obtained from petroleum; hydrogen as well as any other compound," said Martin Olazar, project leader and professor of the Department of Chemical Engineering. The reactor developed and patented by this research group, the conical spouted bed reactor, is highly suited to this process because it is suitable for handling irregular, sticky materials—biomass is a highly irregular material and difficult to handle using conventional technologies.

**Artificial neural networks to determine gross calorific value**

In the design of the process to obtain bio-oils from biomass, researchers must determine certain variables: the temperature that needs to be achieved, how to achieve this temperature, how much fuel (in this case how much biomass) needs to be burned, etc. The gross calorific value is a key parameter in determining this data: it is the heat (energy) that is released when a certain quantity of fuel is completely burned. This parameter is essential in the analysis, design and improvement of biomass pyrolysis, gasification and combustion systems. The correlations existing in the literature give highly variable results depending on each type of biomass and its properties. So the researchers in the group used artificial neural networks to calculate these parameters and have proven empirically that the system gives very good results.

Artificial neural networks are computer models based on the way biological neural networks function; the input and output databases are correlated through them. The researchers fed the system with data from the literature and from their own research and obtained highly reliable results compared with the limited correlations existing in the literature. "These neural networks must be continually fed," explained Olazar, "as the results improve when broader case studies are incorporated. Through a simple composition analysis and by incorporating some regular data into the system (such as density and humidity, for example), the neural network provides us with the gross calorific value of the biomass we have available," he explained. "And that way, we can more easily launch the calculations needed for our design. This is one of the links in the chain of the process to obtain synthetic petroleum using our technology and it is a hugely useful link," concluded Olazar.

**More information:** Idoia Estiati et al. Fitting

performance of artificial neural networks and empirical correlations to estimate higher heating values of biomass, *Fuel* (2016). DOI: 10.1016/j.fuel.2016.04.051

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