Unavoidable energy recovery from cogeneration unit by biomass drying

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Highly efficient power stations produce electricity and superheated water for industrial and domestic uses (processes and heating). These plants generate unavoidable energies (low water temperature). To obtain the best performances, this return water must be cooled before reuse through a cooling tower. In France, the grid-connected tariff of power is proportional to the plant efficiency. An alternative to increase the profit is the use of unavoidable energy as extra energy purpose [1].In this way, drying of biomass is a process that can use and recovery low temperature heat. Indeed, a large amount of available biomass used for energy production presents high moisture content, and then drying can provide a net gain of energy [2].

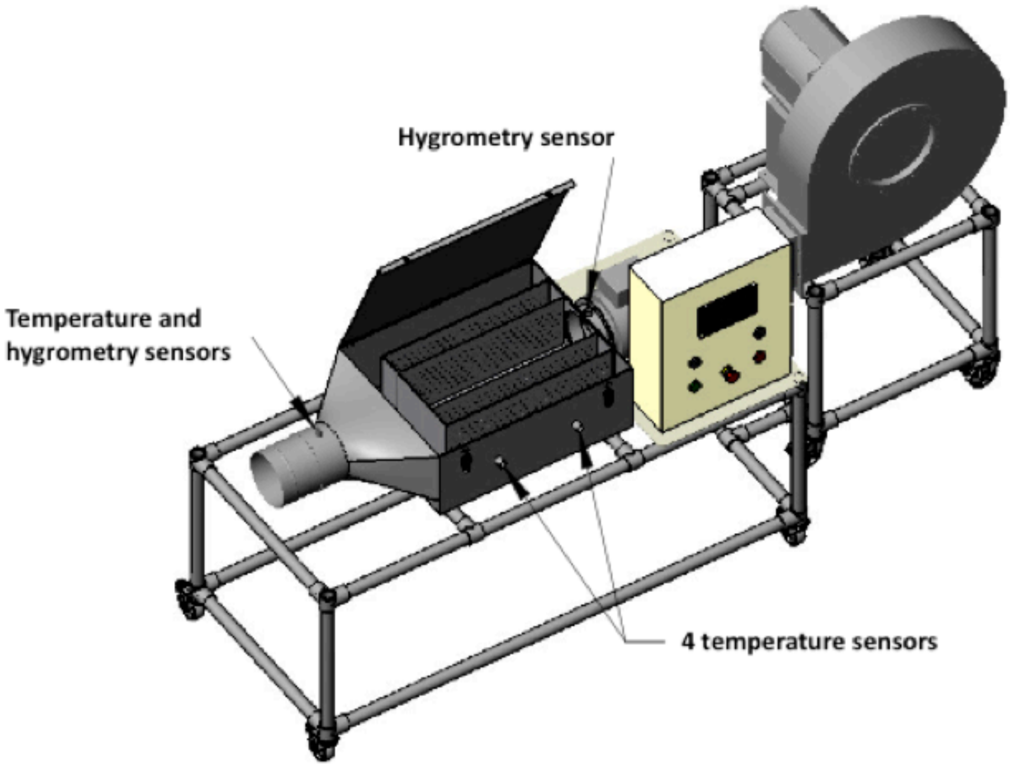

Figure 1: Experimental setup designed for studying the drying kinetics of specific biomass at low temperature

In this context, the purpose of this work is to the study the best scenario for the drying of biomass according to the available energy (in terms of temperature). Indeed, the unavoidable energy supply is at low temperature and requires studying drying kinetic of the biomass to optimize the heat recovery. The drying kinetics of different wet biomass (wood chips, sawdust,…) are estimated with a drying unit at laboratory scale for different operating conditions (air temperature, air humidity, air flow rate, cell porosity, …) (Figure 1).

First, the thermo-physical properties of biomass are studied at different humidity. The thermal conductivity of a bed of biomass is investigated by guarded hot plate method (example of sawdust thermal conductivity vs. humidity in figure 2). The density of the biomass is calculated by differential weighting whereas apparent density of the bed of biomass is estimated by weighting a known volume. Both densities allow the estimation of the bed porosity. The heat capacity of biomass is measured by differential scanning calorimetry.

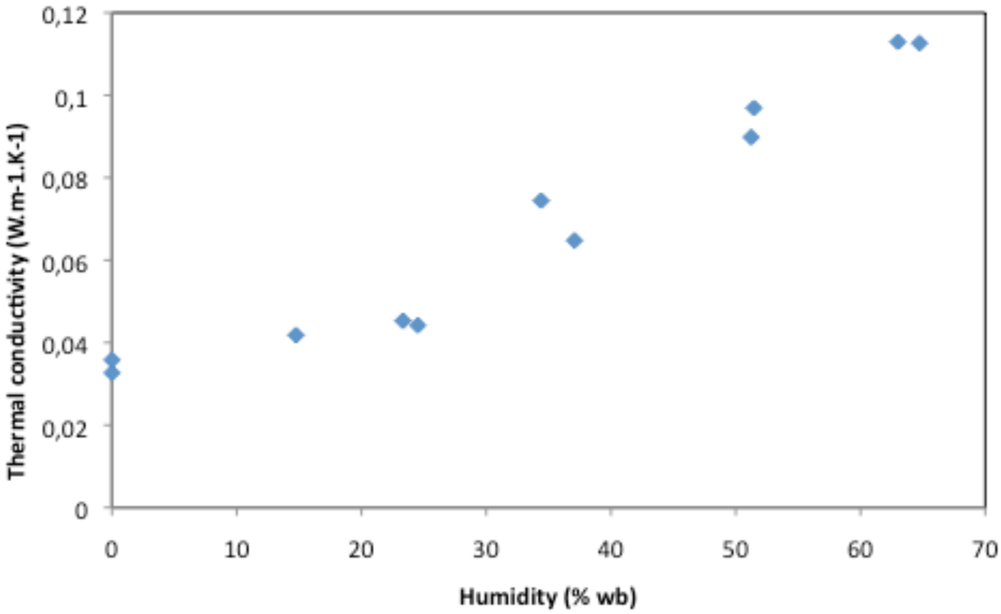

Figure 2: thermal conductivity of a bed of sawdust at different moistures (wet basis).

In parallel, a numerical modeling is developed especially for this study, integrating energy and mass balances. The design of the drying cell as well as the inlet and outlet parameters determined during the experimental investigations are used to determine the boundary conditions of the model, in order to keep close to the used conditions. As a result, after the model parameters adjustment according to the experimental results, the numerical tool is used to achieve operating abacus.

The ultimate goal of this work is to obtain the best cogeneration plant efficiency by biomass drying from available heat.

References

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