Creating a Data Base (DB) to Promote the Utilization of Biomass

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Introduction

There are various types of biomass such as wood from forestal biomass, straw from agricultural biomass, and their residues (waste). And there are all sorts of wood: green wood with a high water content, cut dried wood obtained from sawmills, discarded lumber from construction sites, etc. There are many ways to utilize these biomasses as energy, such as for heat, electric power generation, and conversion to gas and liquid fuels. And there are various conversion methods depending on the type of biomass. How will we choose which one to use, and which way shall we convert it so as to efficiently use the available biomass? We are working on the creation of a data base (DB) to answer these questions and to design the optimum biomass utilization system which is environmentally friendly and economically efficient.

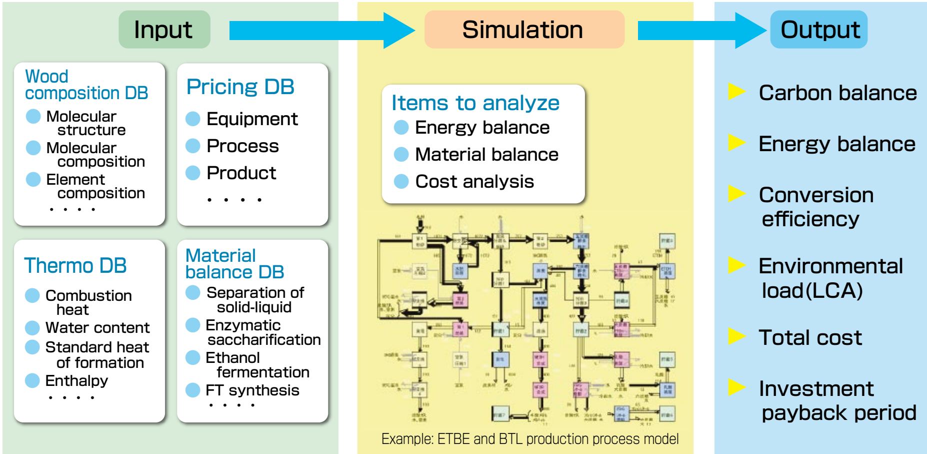

Fig.1 : Biomass utilization system design flow

System Design Flow and Biomass DB

Fig. 1 shows the calculation flow from DB. First, input the biomass type to be used in order to design a process to obtain the desired energy product (process model of the simulation). For heat, it is enough to burn it. However, to produce ethanol or ETBE from wood as a gasoline substitution, processes such as component separation, saccharification, fermentation, and the collection of ethanol by distillation are required. When the process model is complete, the material balance of the whole process can be calculated by recording wood composition data and material balance data in the process model.

The next step is to calculate the necessary heat and power for the process on the basis of the thermophysical properties of the raw materials, end products, and intermediate products. With the pricing data, the cost of main equipment can be calculated and the construction costs of the plant can be estimated. As a result, the efficiency and total cost of the designed system can be obtained, and the carbon dioxide savings when compared to petroleum can be calculated on the basis of product yield. In addition, from the product price and total cost, economic indices such as the investment payback period, can be output.

With the DB of wood components and thermophysical properties, one can examine how total efficiency and product yield rate vary with wood type, and the effect on total economic efficiency when the

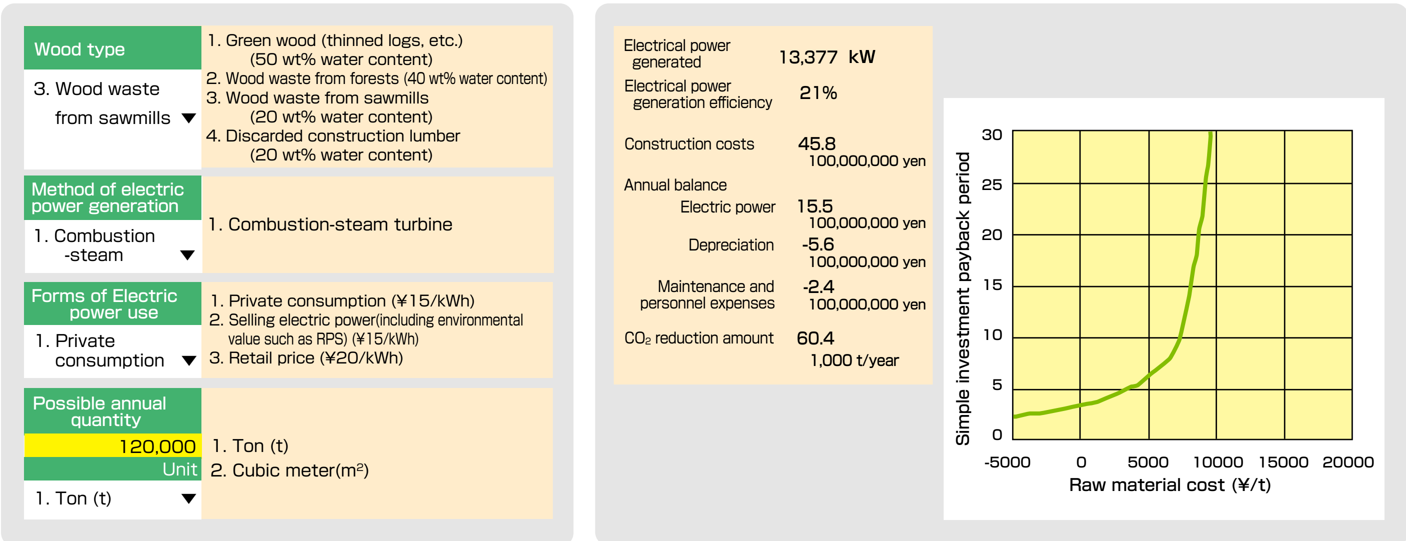

Fig.2 : Input screen image (left) and output screen image (right) of the simplified simulator

process is partially changed. Every time a new system is being considered, usually researchers themselves must investigate and collect the necessary data. However, if such a DB is prepared, not only will the chore of data collection be lightened, but expanding the DB will make technology or use comparisons easier as well.

Simplified Simulation Example Using DB

Though detailed investigations will be needed for practical utilization, using DB permits simplified examination. DB is currently under construction, however, we elaborated an electrical power generation case as a simplified simulation example.

Fig. 2 shows an input image and an output image. By recording wood type, electrical cost, and potential annual yield (scale), the resulting electric power generation scale, efficiency, total construction costs, annual balance, and the carbon dioxide savings will be estimated. The example shows the scenario when 120,000 tons of woodcutting wastes were consumed in one year at private-consumption electrical rates. It is possible to examine how economic efficiency can be improved, or which type of project can be considered, by performing a case study simply by changing the input data.

ETBE/BTL Integrated Production System using Biomass

The Biomass Technology Research Center of AIST is working on the research and development of the important future step to convert woody biomass to liquid fuels, specifically, the production of the gasoline additive ETBE, and diesel fuel which is synthesized by gasification and indirect liquefaction. We are working on the design of an integrated system for the production of ETBE/BTL as shown in Fig. 3. It performs several processes: the separation of cellulose and lignin, the main components of wood; the saccharification and fermentation of cellulose to produce ethanol; the production of ethanol to ETBE; the production of diesel fuel by gasification and indirect liquefaction of lignin, etc., obtained in the separation process; and the process that offers utilities of the whole system.

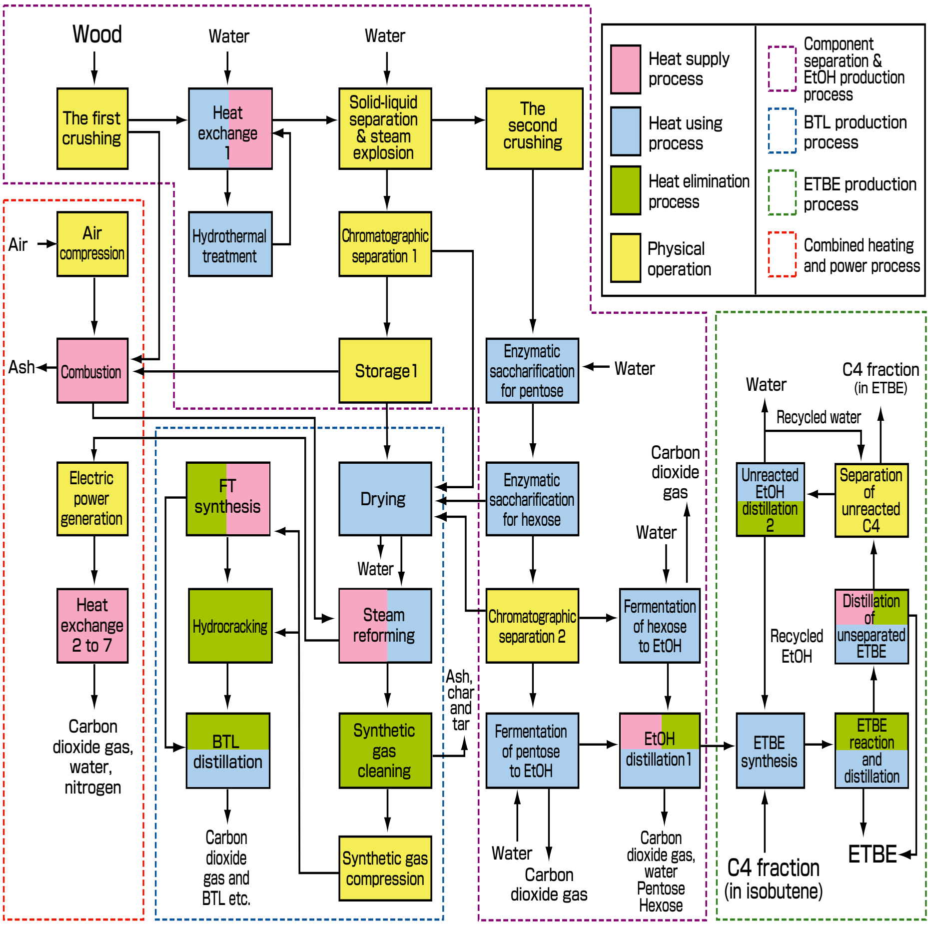

Fig.3 : Basic flow chart of the ETBE/BTL integrated production system from biomass

The construction and use of DB make it possible to examine the economic efficiency of an ETBE/BTL integrated production system and to plot a course for the development of technology by sensitive analysis. Inversely, performing these simulated case studies can expand the DB.

Future Activities

We believe that by creating the biomass DB we can contribute to promote biomass utilization as it makes possible system design and simplified simulations. We will not only work on ETBE/BTL production, but will also actively collaborate on various biomass utilization systems, promote research and development by analyzing economic efficiency, and publish simulation results.

In the future, we will perform more case studies in order to improve the contents of DB, so it can be used as a reference when biomass will be utilized.