SUPPLEMENTARY MATERIAL

Intensification of the oligomerization and hydrogenation stage for biojet fuel production: preliminary outlines

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Section 3 Performance Evaluation Indices

The TAC approximation is described in equation S1.

$$TAC\ (\$/kg) = \frac{\frac{\sum_{i=1}^{n} C_{TM,\,i}}{payback\ period} + \sum_{j=1}^{n} C_{ut,j}}{F_k} \tag{S1}$$

The total module cost is calculated from equation S2.

$$C_{TM} = 1.18 \sum_{i=1}^{n} C_{BM,i}^{0} \tag{S2}$$

Where the term C_{BM}^{0} represents the cost of the bare module, which reflects the direct and indirect costs for each unit. This term is calculated by equation S3.

$$C_{BM}^{0} = C_p F_{BM}^{0} \tag{S3}$$

And in most cases $F_{BM}^{0}$is calculated by equation S4.

$$F_{BM}^{0} = (B_1 + B_2 F_M F_P) \tag{S4}$$

Where $C_{TM,i}$ represents the cost of capital of the plant, r the number of years of return on investment, n is the total number of individual units, $C_{ut,j}$ is the cost of services, $C_{BM,i}^{0}$ represents the cost of the bare module, C_p is the purchase cost of the equipment under

base conditions (carbon steel as construction material and ambient operating conditions), F_{BM}^{0} is the cost factor of the bare module which contains all the adjustment factors, FM is the material factor, F_P is the pressure factor, finally B_1 and B_2 are factors that depend on the type of equipment.

The economic study performed considers 5 years as the recovery period. The plant is assumed to run 8500 hours/year. Note that the costs of utilities used here are: high-pressure (HP) steam (42 bar, 254 °C, \$9.88 GJ^{-1}), medium-pressure (MP) steam (11 bar, 184 °C, \$8.22 GJ^{-1}), low-pressure (LP) steam (6 bar, 160 °C, \$7.78 GJ^{-1}), and cooling water (\$0.72 GJ^{-1}) [30]. In the case of reactive columns, the method indirectly estimates the catalyst costs for the reactive zone.

On the other hand, The Global Warming Potential (GWP). The following is how GWP is defined and calculated (equation 3):

$$GWP = \frac{Total\ mass\ of\ CO_2\ equivalents\ (kg)}{Mass\ of\ Product\ (kg)} \qquad \text{(S4)}$$

Note the total mass of CO2 is calculated according to Gadalla et al.. CO2 emissions are related with energy consumption (burned fuel). In this work it is considered to use Natural Gas a fuel, and CO2 emissions are calculated as follow:

$$[CO_2]_{emissions} = \left(\frac{Q_{fuel}}{NHV}\right)\left(\frac{\%C}{100}\right)\alpha \qquad \text{(S5)}$$

Where Q_{fuel} (kW) is the quantity of burned fuel, α=3.67 is the ratio of molar mass between CO2 and C, and NHV represents the net heating value of a fuel containing carbon (C).