Eqs

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1 Paper

Eq1

$$\text{Profit} = \text{BioCH}_4 - \text{Cost}_{\text{AmineSystem}} \tag{1}$$

Eq2

$$\text{Cost}_{\text{AmineSystem}} = \text{C}_{\text{Steam}} \sum_i \frac{Q_i}{\lambda} \cdot \tau_{\text{year}} + \frac{1}{K} \text{Cost}_{\text{Amine}} \cdot \text{fc}_{\text{Amine}} \cdot \tau_{\text{year}} \tag{2}$$

Eq3

$$\text{Profit} = \text{BioCH}_4 - \text{Cost}_{\text{ZeoliteSystem}} \tag{3}$$

Eq4

$$\text{Cost}_{\text{ZeoliteSystem}} = \text{C}_{\text{Electricity}} \cdot W_{\text{Compressor}} + \frac{1}{K} M_{\text{Zeolite}} \cdot C_{Zeolite} \cdot N_{Cycle} \tag{4}$$

Eq5

$$\text{Profit} = BioCH_4 - Cost_{\text{MembraneSystem}} \tag{5}$$

Eq6

$$\text{Cost}_{\text{MembraneSystem}} = \text{C}_{Electricity} \cdot W_{Compressor} + \frac{1}{K} \cdot C_{Membrane} \cdot \frac{1}{Lf} \cdot N_{Membranes}(\sum_{i \in stages} Area_i) \tag{6}$$

Eq7

$$\text{Profit} = BioCH_4 - Cost_{\text{MembraneSystem}} - \text{Cost}_{\text{ZeoliteSystem}} - \text{Cost}_{\text{AmineSystem}} \tag{7}$$

2 Supplementary Material

Eq1

$$\text{fc}_{\text{amine}} = \frac{\text{MW}_{\text{amine}}}{[\text{amine}]} \cdot \left(\frac{\text{CO2}_{e\text{ff}} \cdot \text{fc}_{CO_2}}{\text{MW}_{CO_2}} \right) \cdot \left(\frac{1}{\text{GPSA}} \right) \tag{8}$$

Eq2

$$\text{fc}_{\text{amine}} = \text{fc}_{\text{recycledamine}} + \text{fc}_{\text{freshamine}} \tag{9}$$

Eq3

$$Q = F_{\text{amine}} \cdot q_{\text{heat,amine}} \tag{10}$$

Eq4

$$\text{Q}_{Col1} = \Delta H_{\text{react,amine}} \cdot \text{CO2}_{\text{eff}} \cdot fc_{CO_2} \tag{11}$$

Eq5

$$\begin{aligned} \text{Q}_{Cond} &= F_{\text{Cond}} \cdot q_{\text{Cond,amine}} \\ \text{Q}_{Reb} &= F_{\text{Reb}} \cdot q_{\text{Reb,amine}} \end{aligned} \tag{12}$$

Eq6

$$Q_{Cooling} = F_{Cooling} \cdot q_{Cooling,a\min e} \tag{13}$$

Eq7

$$\mathrm{p_{aminessolution}} = \mathrm{Exp}\left(A - \frac{B}{(C + \mathrm{T_{top}})}\right) \tag{14}$$

Eq8

$$Y = \frac{MW_{Wa}}{MW_{\mathrm{outletgas}}} \cdot \frac{\mathrm{p_{aminessolution}}}{(\mathrm{P}_{Col2} - \mathrm{p_{aminessolution}})} \tag{15}$$

Eq9

$$\begin{aligned} T_{out/compresor} &= T_{in/compressor} + T_{in/compressor}\left(\left(\frac{P_{out/compressor}}{P_{in/compressor}}\right)^{\frac{z-1}{z}} - 1\right)\frac{1}{\eta_c} \\ \mathrm{W}_{(Compressor)} &= (F) \cdot \frac{R \cdot z \cdot \left(\mathrm{T}_{in/compressor}\right)}{((\mathrm{M}w)\cdot(z-1))}\frac{1}{\eta_c}\left(\left(\frac{P_{out/compressor}}{P_{in/compressor}}\right)^{\frac{z-1}{z}} - 1\right) \end{aligned} \tag{16}$$

Eq10

$$\begin{aligned} &\mathrm{CO_2stream}: \\ &fc_{CO_2}|_{out} = \eta\, fc_{CO_2}|_{in} \\ &fc_{CH_4}|_{out} = 0.02 \cdot\ fc_{CH_4}|_{in} \\ &\mathrm{CH_4stream}: \\ &fc_{CO_2}|_{out} = (1-\eta)\, fc_{CO_2}|_{in} \\ &fc_{CH_4}|_{out} = 0.98 \cdot\ fc_{CH_4}|_{in} \end{aligned} \tag{17}$$

Eq11

$$q = \frac{q_m \cdot K \cdot P_{CO_2}}{1 + K \cdot P_{CO_2}} \tag{18}$$

Eq12a and 12b

$$\begin{aligned} q_m &= -3.1555110^{-2}T(^{\circ}\mathrm{C}) + 5.02915 \\ K &= 1.6307010^{(}-03)T(^{\circ}\mathrm{C})^2 - 3.6866210^{(}-01)T(^{\circ}\mathrm{C}) + 27.3737 \end{aligned} \tag{19a}$$

$$\begin{aligned} q_m &= -1.8235510^{-2}T(^{\circ}\mathrm{C}) + 3.72021 \\ K &= \ 1.6307010^{-03}T(^{\circ}\mathrm{C})^2 - 3.6866210^{-1}T(^{\circ}\mathrm{C}) + 27.3737 \end{aligned} \tag{19b}$$

Eq13

$$m_{Zeolite} = \frac{1}{q \cdot 0.65} \frac{fc_{CO_2} \cdot 1000}{MW_{(CO_2)}} \eta \cdot \tau \tag{20}$$

Eq22

$$\mathrm{Profit} = \mathrm{BioCH_4} - \mathrm{Cost_{ZeoliteSystem}} \tag{21}$$

Eq23

$$\mathrm{Cost_{ZeoliteSystem}} = \mathrm{C_{Electricity}} \cdot W_{\mathrm{Compressor}} + \frac{1}{K} M_{\mathrm{Zeolite}} \cdot C_{Zeolite} \cdot N_{Cycle} \tag{22}$$

Eq14

$$F_{feed} = F_{permeate} + F_{retentate} \tag{23}$$

Eq15

$$F_{feed} \cdot y_{i,feed} = F_{permeate} \cdot y_{i,permeate} + F_{retentate} \cdot y_{i,retentate}; i \in (CO_2, CH_4) \tag{24}$$

Eq16

$$J_i = \frac{F_{permeate} \cdot y_{i,permeate}}{A_{membrane}}; i \in (CO_2, CH_4) \tag{25}$$

Eq17

$$J_i = \varepsilon_i \left[y_{feedside} \cdot P_{feed} - y_{i,permeate} \cdot P_{Permeate} \right]; i \in (CO_2, CH_4) \tag{26}$$

Eq18

$$y_{feedside} = \frac{y_{i,feed} - y_{i,retentate}}{\ln\left(\frac{y_{i,feed}}{y_{i,retentate}}\right)}; i \in (CO_2, CH_4) \tag{27}$$

Eq19

$$\varepsilon_i = \frac{Perm_i}{\delta}; i \in (CO_2, CH_4) \tag{28}$$

Eq20

$$\text{Profit} = BioCH_4 - Cost_{\text{MembraneSystem}} \tag{29}$$

Eq21

$$\text{Cost}_{\text{MembraneSystem}} = \text{C}_{Electricity} \cdot W_{Compressor} + \frac{1}{K} \cdot C_{Membrane} \cdot \frac{1}{Lf} \cdot N_{Membranes} \left(\sum_{i \in stages} Area_i \right) \tag{30}$$

Eq22

$$D_C = 44 \sqrt{\frac{F_{gas}(MMsfd)}{P(psia)}} \tag{31}$$

Eq23

$$D_R = 3.0 \sqrt{F_{a\min e}(gal/\min)} \tag{32}$$