HW8_1

April 11, 2022

1 Homework 8

1.1 Problem 1.a

Determine the exit gas composition.

The problem states that the exit liquid contains 78.4% of the CO_2 in the feed gas so the balance must go the the exit vapor which suggests,

$$Y_1 = 0.216\frac{0.10}{0.90} = 0.024$$

It is also known that

$$y_1 = \frac{Y_1}{1+Y_1} \tag{1}$$

so $y_1 = 0.023$

[ ]:
```
YNp1 = .1/.9
X0 = 0.04
Y1 = .216*.1/.9
↪         #vap leaving
y1 = Y1/(1+Y1)
```

1.2 Problem 1.b

Determine the moles of amine solution required per mole of feed gas.

The following code plots the data and uses a guess and check method to adjust the slope until Y_{N+1} is close to the expected value of 0.111.

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import scipy.interpolate as interp
```

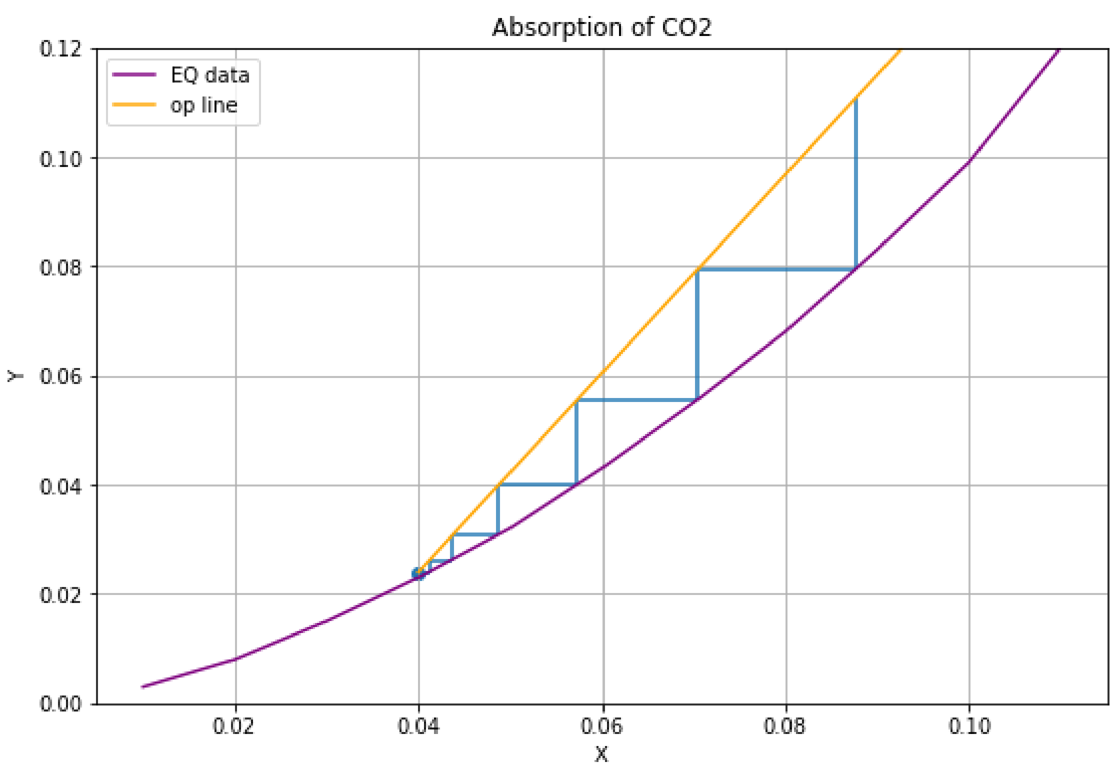
[ ]:
```
X = np.array([.01,.02,.03,.04,.05,.06,.07,.08,.09,.1,.11])
↪         #co2/air
Y = np.array([.003,.008,.015,.023,.032,.043,.055,.068,.083,.099,.12])
↪         #co2/amine
```

```
xinterp = interp.interp1d(Y,X,kind='cubic')                    ␣
 ↪         #interpolation of data
slope = 1.82                                                     ␣
 ↪#guess
def Ynp1(XN):                                                    ␣
 ↪         #returns op line
    return (XN-X0)*slope+Y1
dep = np.linspace(.04,.11)
```

[ ]:
```
plt.figure(figsize=(9,6))
plt.plot(X,Y,color='purple',label='EQ data')
plt.scatter(X0,Y1)
plt.plot(dep,Ynp1(dep),color='orange',label='op line')
plt.legend()
plt.ylabel('Y')
plt.xlabel('X')
plt.title('Absorption of CO2')



# print(y6/YNp1)
# while y6/YNp1 <=1.5 and y6/YNp1 > .8:



x1 = xinterp(Y1)                                              ␣
 ↪#lines connecting eq and op lines
y1 = Ynp1(x1)
x2 = xinterp(y1)
y2 = Ynp1(x2)
x3 = xinterp(y2)
y3 = Ynp1(x3)
x4 = xinterp(y3)
y4 = Ynp1(x4)
x5 = xinterp(y4)
y5 = Ynp1(x5)
x6 = xinterp(y5)
y6 = Ynp1(x6)
x7 = xinterp(y6)                                            # only␣
 ↪has 6 stages. use x7,y7 to check
y7 = Ynp1(x7)





plt.hlines(Y1,X0,x1)
```

```
plt.vlines(x1,Y1,y1)
plt.hlines(y1,x1,x2)
plt.vlines(x2,y1,y2)
plt.hlines(y2,x2,x3)
plt.vlines(x3,y2,y3)
plt.hlines(y3,x3,x4)
plt.vlines(x4,y3,y4)
plt.hlines(y4,x4,x5)
plt.vlines(x5,y4,y5)
plt.hlines(y5,x5,x6)
plt.vlines(x6,y5,y6)
# plt.hlines(y6,x6,x7)
# plt.vlines(x7,y6,y7)
plt.ylim(0,.12)
plt.grid()
;
```

```
[ ]: ''
```



Since the slope is $\frac{L'}{V'}$, and V' is known from the problem statement to be 0.90, L' can be solved

$$L' = 1.82V' = 1.64$$