EQUILIBRIUM SOLUBILITY MEASUREMENT AND MODELING OF CO_2 ABSORPTION IN AQUEOUS BLEND OF 2-(DIETHYLAMINO)ETHANOL AND 2-(2-AMINOETHYLAMINE)ETHANOL

ABSTRACT

In this work, new experimental CO_2 solubility data at equilibrium in aqueous blend of 2-(Diethylamino)ethanol (DEEA) and 2-(2-aminoethylamine)ethanol (AEEA) have been illustrated for concentration of CO_2 in the inlet gas stream ranging from (10.132 to 20.265) kPa and aqueous amine blend temperature ranging from (303.15 to 333.15) K. Total concentrations of aqueous blend were taken in the range of 1.0-3.0 kmol/m^3 and mole fraction of AEEA in total amine blend in the range of 0.02-0.20. Experiments were carried out in a semi-batch operated laboratory scale gas-liquid bubbling absorber and analysis of liquid phase CO_2 as a saturated liquid was done by titration method. The equilibrium CO_2 solubility in DEEA+AEEA blend was found to be maximum at the value of 0.843 mol CO_2/mol amine with AEEA mole fraction in total amine of 0.2 at 1 kmol/m^3 total concentration of amine mixture and 303.15 K. New solubility data of CO_2 in the present work was compared with existing literature data. The empirical solubility model was developed from our experimental CO_2 solubility data as function of operating variables in studied range.

4.1 INTRODUCTION

In recent years, global warming and its potential effect on climate change are the serious environmental issues caused by anthropogenic emission of CO_2 into the atmosphere and its major contribution of approximately 60% in enhanced greenhouse effect (Metz et al., 2007). Fossil fuel based thermal power plant is one of the major anthropogenic sources of CO_2 emissions worldwide (Adams and Davison, 2007). Global carbon emissions from fossil fuels increased by 16 times since from 1900 to 2008 and by about 1.5 times between 1990 and 2008 (Boden et al., 2010). So, for the removal of CO_2 from industrial process gas streams, various capture and separation technologies of CO_2 are available. Several separation technologies for CO_2 removal from gas streams are physical absorption, chemical absorption, adsorption, cryogenic, and membrane separation. Among these, the removal of CO_2 from power plant flue gas using chemical absorption technology is most preferred because CO_2 can separate from exhaust gas stream to a very low concentration. Currently, absorption with amine-based chemical absorbents is most matured and has been commercially used for post-combustion CO_2 capture in a fossil-fuel based thermal power plant (Tontiwachwuthikul et al., 2011; Rochelle, 2009). The different promising categories of alkanolamines used for capturing CO_2 are such as primary amines like monoethanolamine (MEA) and diglycolamine (DGA), secondary amines like diethanolamine (DEA) and di-isopropanolamine (DIPA), tertiary amines like N-methyl diethanolamine (MDEA) and triethanolamine (TEA), and sterically hindred amines like 2-amino-2-methyl-1-propanol (AMP), etc. (Kohl and Nielsen, 1997). Also, another popular category of amines are cyclic diamine piperazine (PZ) and non-cyclic diamine 2-(2-aminoethylamine)ethanol (AEEA) (Ma'mun et al., 2007; Aronu et al., 2009 have been used as an activator for CO_2 capture (Bindwal et al., 2011). Primary and secondary alkanolamines react with CO_2 to form more stable carbamates and these require high heat for desorption leading to high solvent regeneration cost. The sterically hindered amines form less stable carbamate due to a large group attached to the nitrogen atom. So, it has limited CO_2 loading capacity of 0.5 mol of CO_2 per mol of amine (Mondal, 2009). But, tertiary amine cannot form carbamates with CO_2 which facilitates the CO_2 hydrolysis reaction forming bicarbonates as a final product with the CO_2 loading capacity of 1.0 mol of CO_2 per mol of amine (Albo et al., 2015). Also, tertiary amines are more preferred than primary and secondary amines due to high absorption capacity and requiring less amount of heat during regeneration (Chowdhury et al., 2013). But, due to slow reaction rate of tertiary amine with CO_2, it requires the addition of other amines as an activator such as a primary amine, secondary amine, cyclic amine and polyamines for enhancing the overall CO_2 absorption performance. Particularly, DEEA as a novel tertiary amine shows better absorption performance than MDEA as a conventional tertiary amine (Chowdhury et al., 2013; Puxty et al., 2009). Also, it can be prepared from renewable sources as an agriculture products/residue and also have a good potential for CO_2 capture from process gas stream (Vaidya and Kenig, 2009; Vaidya and Kenig, 2007). The polyamine AEEA is a potential absorbent because it has high absorption rate, high CO_2 cyclic capacity, high values of second-order reaction rate, and lower regeneration energy (Ma'mun et al., 2007). But, it may not be efficient for CO_2 capture individually because it revealed to show degradation behavior. So, AEEA may be used as an activator only (Aronu et al., 2009). The reactivity for CO_2 with alkanolamine is in the order of polyamine > cyclic amine > primary > secondary > tertiary (Rayer et al., 2011). Although, absorption of CO_2 in a single solvent DEEA have widely studied by various researchers to measure CO_2 equilibrium solubility as well as absorption heat and modeling of vapor-liquid equilibrium (VLE) data in DEEA-H_2O system (Xu et al., 2014; Arshad et al., 2014; Monteiro et al., 2013; Luo et al., 2016a).

Recently, for more improving the CO_2 capture performance, a mixture of DEEA as a base solvent and AEEA as an activator has a new research interest due to advantages of both amines. Many researchers have investigated for CO_2 capture performance parameters in terms of absorption capacity, absorption rate, absorption heat, absorption flux, absorption co-efficient and reaction rate constant of CO_2 etc. in several DEEA based aqueous blend systems such as DEEA+ MAPA (Liebenthal et al., 2013; Gao et al., 2016), DEEA+PZ (Vaidya and Kenig, 2008; Konduru et al., 2010; Fu et al., 2016a; Sutar et al., 2013; Gao et al., 2016), DEEA+MEA (Fu et al., 2016b; Luo et al., 2016b; Conway et al., 2015; Gao et al., 2016), DEEA+BDA (Xu et al., 2013), DEEA+EAE (Vaidya and Kenig, 2009; Vaidya and Kenig, 2007; Chen and Liao, 2014; Gao et al., 2016), DEEA+HMDA (Sutar et al., 2013), DEEA+DETA (Gao et al., 2016), DEEA+TETA (Gao et al., 2016), DEEA+AMP (Gao et al., 2016), DEEA+DEA (Gao et al., 2016), and DEEA+AEEA (Sutar et al., 2013; Gao et al., 2016). Although, a little information is available on equilibrium CO_2 solubility (loading) in DEEA+AEEA blend, but it requires more data at different operating conditions for rational design and operation in gas separation unit for CO_2 capture process in coal based thermal power plant. Also, for the design and operation of absorption-desorption columns for CO_2 capture process, it requires detailed knowledge of CO_2 capture performance parameters. But, solubility of CO_2 in amine blends is extremely important due to its prime steps design parameter for the determination of absorption capacity and its major role in the selection of any novel potential solvents. So, the present work is based on the improvement in CO_2 absorption in an aqueous blend of DEEA and AEEA.

The main purpose of this work is to study the CO_2 solubility in an aqueous blend of DEEA and AEEA, at different operating conditions, because CO_2 is present in the exhaust gas stream emitted from power plant and the concentration of CO_2 in gas stream exhibits less than 20% by volume at atmospheric pressure. Therefore, CO_2 equilibrium solubility in DEEA+AEEA blends has been determined at absorbent blend concentration in the range of 1-3 kmol/m^3, temperature range of 303.15-333.15 K, CO_2 partial pressure range of 10.132-20.265 kPa and AEEA mole fraction in total amine ranging from 0.02 to 0.20. The present study experimental solubility data of CO_2 in this blend have also been compared with available literature data. Also, an empirical solubility model has been developed by using experimental solubility data in the range of operating variables.

4.2 EXPERIMENTAL

4.2.1 Chemicals and materials

The analytical reagent (AR) grade chemicals, DEEA and AEEA were purchased from Sisco Research Laboratory Pvt. Ltd., Mumbai. The DEEA+AEEA blend solutions were prepared at room temperature using double distilled water without any purification to various working concentrations as per requirement. The CO_2 simulated gas stream of desired concentration (10 to 20% by volume) was prepared in gas simulation chamber by mixing of gas streams from two cylinders (one cylinder containing 20% CO_2 with balance N_2 and another cylinder containing 99.99 % N_2). The volume of gas was measured by gas flow rotameter. The infrared flue gas analyzer (model: Gas Board-3800P; Wuhan Cubic Optoelectronics Co. Ltd., Wuhan, China; with CO_2 ranges: 0-100% by volume) was used for the gas phase CO_2 analysis, with an accuracy of ±0.1%. A constant-temperature water bath (model: CE404, Narang Scientific Works Pvt. Ltd., New Delhi, India) was used to set the operating temperature of amine blend (273 K to 473 K) within minute variation of ±0.1 K. Others chemicals (NaOH, $BaCl_2.2H_2O$, HCl) were of analytical reagent (AR) grades used for analysis of CO_2 in liquid phase.

4.2.2 Experimental setup and Procedures

The experimental set-up described in our previous publication (Mondal, 2009) was used in the present work with some little modification. The experimental set-up was used for the measurement of CO_2 solubility in an aqueous blend of DEEA and AEEA. A schematic diagram of the experimental set-up has been shown in figure 4.1. This setup is divided into three parts; first: preparation of simulated CO_2 gas stream, second: absorption of gases in absorber, and third: analysis of liquid phase gas stream. The borosilicate glass gas-liquid contactor as bubbling absorber containing 100 ml aqueous blend of DEEA and AEEA was placed inside water bath, with the temperature set to the desired point. Thermometers with sub-divisions of 0.1 K were used to measure both the water bath and the liquid temperature inside the absorber. First, N_2 gas stream was purged through the absorber for approximately 10 min for removal of trace gases which is present initially. Then, a fixed concentration of simulated CO_2 gas stream was passed through gas flow rotameter with a minimum flow rate of approximately 0.5 dm^3/min inside absorber and maintained a continuous flow of gas with non-disturbance of bubbles at the upper layer of the liquid. After a regular interval of time (10 min), the outlet gas stream concentration coming out from absorber through moisture absorber column was analyzed by infrared flue gas analyzer and this procedure was continued until the concentration of CO_2 gas stream in inlet and outlet are nearly same, indicating that liquid becomes saturated. Then, the equilibrium CO_2 loading in the liquid phase was measured by a titration method with HCl (6M) solution using phenolphthalein indicator followed by methyl orange indicator until to reach the endpoint (Bajpai and Mondal 2013). At a given temperature and pressure, at least two aliquot samples were taken to check the reproducibility, and the data were found to be reproducible to within 1%. The temperature was controlled within ±0.1 K from 303.15 to 333.15 K and the total pressure was monitored for each run with an uncertainty 0.01 kPa from 10.133 to 20.265 kPa.

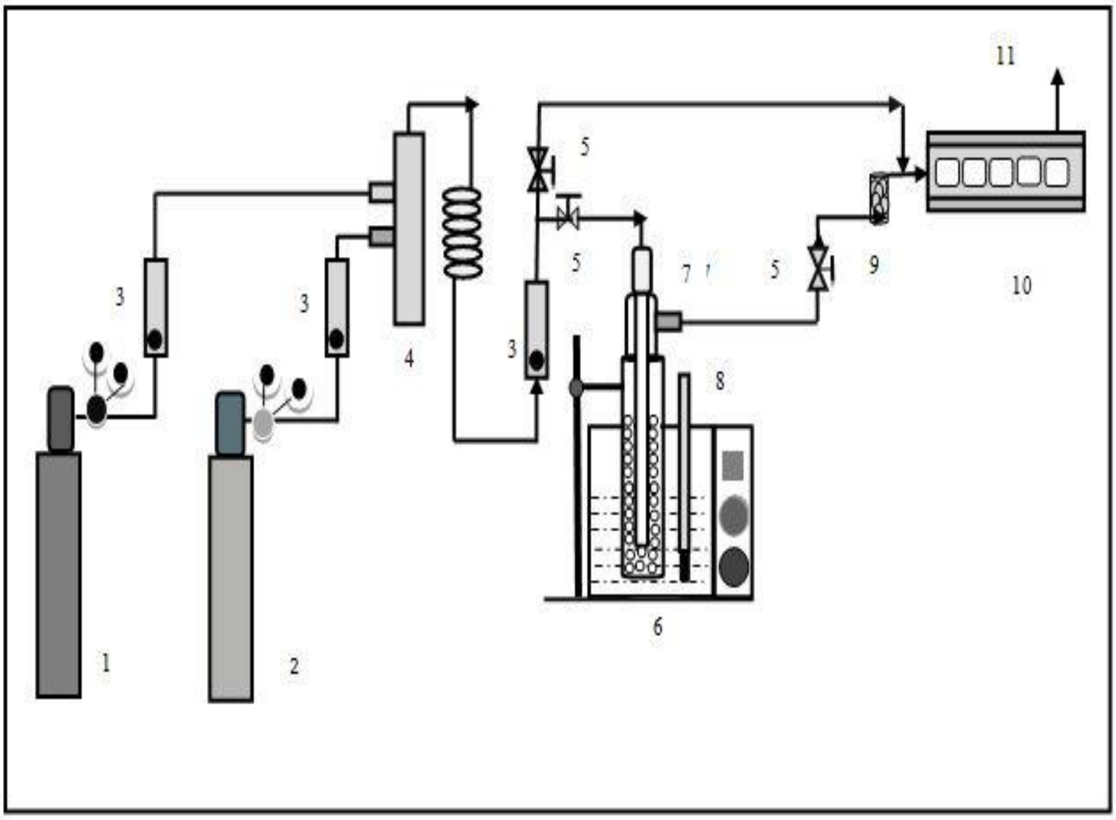

Figure 4.1 Schematic diagram of the experimental set-up: (1) CO_2 gas cylinder, (2) N_2 gas cylinder, (3) gas-flow rotameter, (4) gas mixing chamber, (5) stainless steel valves, (6) water bath, (7) bubbling absorber, (8) thermometer, (9) moisture absorber column, (10) flue gas analyzer and (11) exhaust

4.2.3 Reaction chemistry of CO_2-DEEA-AEEA system

The reaction mechanisms for CO_2 absorption in an aqueous blend of DEEA and AEEA have been discussed in details in appendix B.1.

Table 4.1 Experimental data on the solubility of CO_2 in aqueous DEEA + AEEA blend

Run	X	$C_T\,(kmol/m^3)$	$T(K)$	$p_{CO2}\,(kPa)$	α_{CO2} (mol CO_2/mol total amine)
1	0.02	1	313.15	20.265	0.494
2	0.02	2	313.15	20.265	0.446
3	0.02	3	313.15	20.265	0.412
4	0.1	1	313.15	20.265	0.664
5	0.1	2	313.15	20.265	0.584
6	0.1	3	313.15	20.265	0.521
7	0.2	1	313.15	20.265	0.815
8	0.2	2	313.15	20.265	0.789
9	0.2	3	313.15	20.265	0.699
10	0.2	1	313.15	10.133	0.601
11	0.2	1	313.15	12.666	0.659
12	0.2	1	313.15	15.199	0.706
13	0.2	1	313.15	17.732	0.803
14	0.2	1	313.15	20.265	0.815
15	0.2	2	313.15	10.133	0.572
16	0.2	2	313.15	12.666	0.614
17	0.2	2	313.15	15.199	0.683
18	0.2	2	313.15	17.732	0.782
19	0.2	2	313.15	20.265	0.789
20	0.2	1	303.15	20.265	0.843
21	0.2	1	313.15	20.265	0.815
22	0.2	1	323.15	20.265	0.738
23	0.2	1	333.15	20.265	0.613
24	0.2	2	303.15	20.265	0.832
25	0.2	2	313.15	20.265	0.789
26	0.2	2	323.15	20.265	0.707
27	0.2	2	333.15	20.265	0.586

4.3 RESULTS AND DISCUSSION

4.3.1 Solubility of CO_2 in DEEA+AEEA solution

The CO_2 solubility in an aqueous blend of DEEA and AEEA was measured for a total blend concentrations (C_T) in the range of (1.0-3.0) kmol/m^3, mole fraction of AEEA (X) in total blend ranging from 0.02 to 0.20, aqueous DEEA+AEEA blend temperature in the range of (303.15-333.15) K and CO_2 partial pressures in the range of (10.13-20.26) kPa. The experimental data of CO_2 solubility in (DEEA+AEEA+H_2O) ternary system are reported in table 4.1, whereas the CO_2 solubility (loading) has expressed as the number of moles of CO_2 absorbed per mole of total amine blend.

4.3.1.1 Effect of concentration

Figure 4.2 shows the change in the liquid phase CO_2 concentration with respect to absorption time for different mole fraction of AEEA in a fixed concentration of total amine blend. The influence of AEEA mole fraction on CO_2 solubility was investigated by varying the mole fraction of AEEA in the aqueous blend from 0.02 to 0.20 with changing proportions of amine blend for a total blend concentration of 2 kmol/m^3. For a fixed AEEA mole fraction with a particular concentration of amine blend, the CO_2 absorbed amount increases with absorption time and then remains constant which reveals that no more amount of CO_2 is dissolved in this blend and solution becomes completely saturated to achieve equilibrium. Figure 4.3 shows the variation of CO_2 solubility with AEEA mole fraction ranging from 0.02 to 0.20, for different amine blend concentrations in the range of 1-3 kmol/m^3. Further, from figure 4.3, it can be clearly seen that the solubility of CO_2 increases with increasing value of AEEA mole fraction in total amine blend and the maximum value of CO_2 solubility was observed at AEEA mole fraction of 0.2. The enhancement of CO_2 solubility in the liquid by blending with AEEA can be explained by the fact that AEEA has primary and secondary amino groups which increases the reaction sites resulting in increasing CO_2 absorption (Rayer et al.2011).

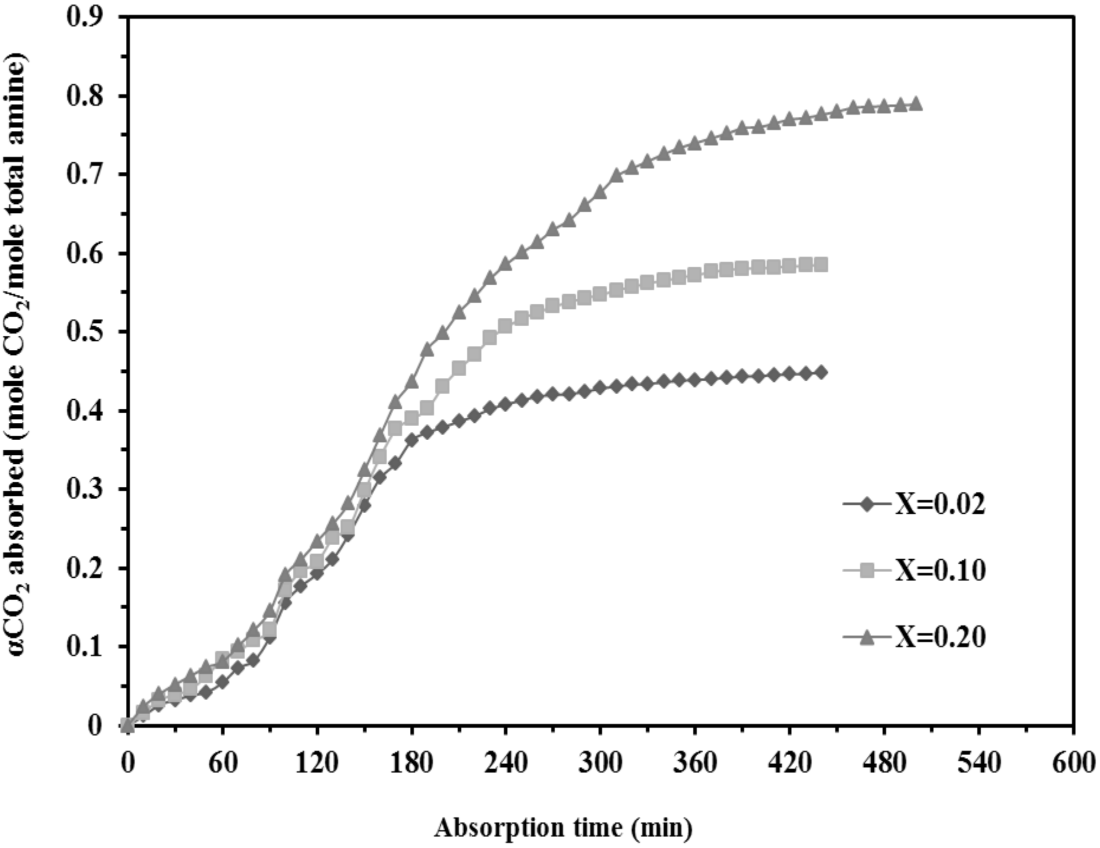

Figure 4.2 Variation of the CO_2 solubility α_{CO_2} with absorption time for different mole fraction of AEEA in total amine (X) of ▲, 0.20; ■, 0.10 and ♦, 0.02, at C_T 2 kmol/m^3 and p_{CO2} 20.265 kPa

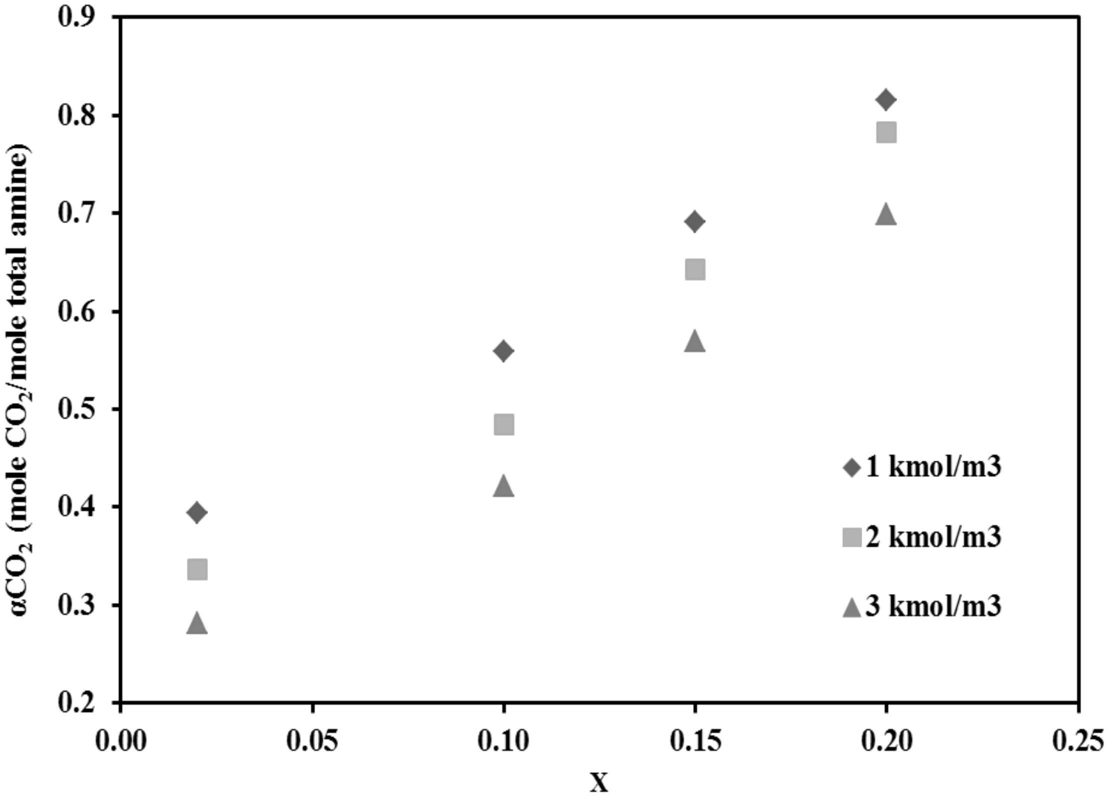

Figure 4.3 CO_2 solubility α_{CO_2} with different AEEA mole fraction in total amine X for total amine concentration C_T of ♦, 1 kmol/m^3; ■, 2 kmol/m^3; ▲, 3 kmol/m^3, at T 313.15K and pCO_2 20.265 kPa

Figure 4.4 shows the influence of DEEA+AEEA blend concentration on the CO_2 solubility at a temperature of 313.15 K, CO_2 partial pressure of 20.265 kPa, and AEEA mole fraction of 0.2. From figure 4.4 it is observed that there is a decrease in CO_2 solubility with an increase in amine blends concentration because at a higher concentration a smaller extent of the reversion of carbamate to bicarbonate can occur (Ma’mun et al., 2006).

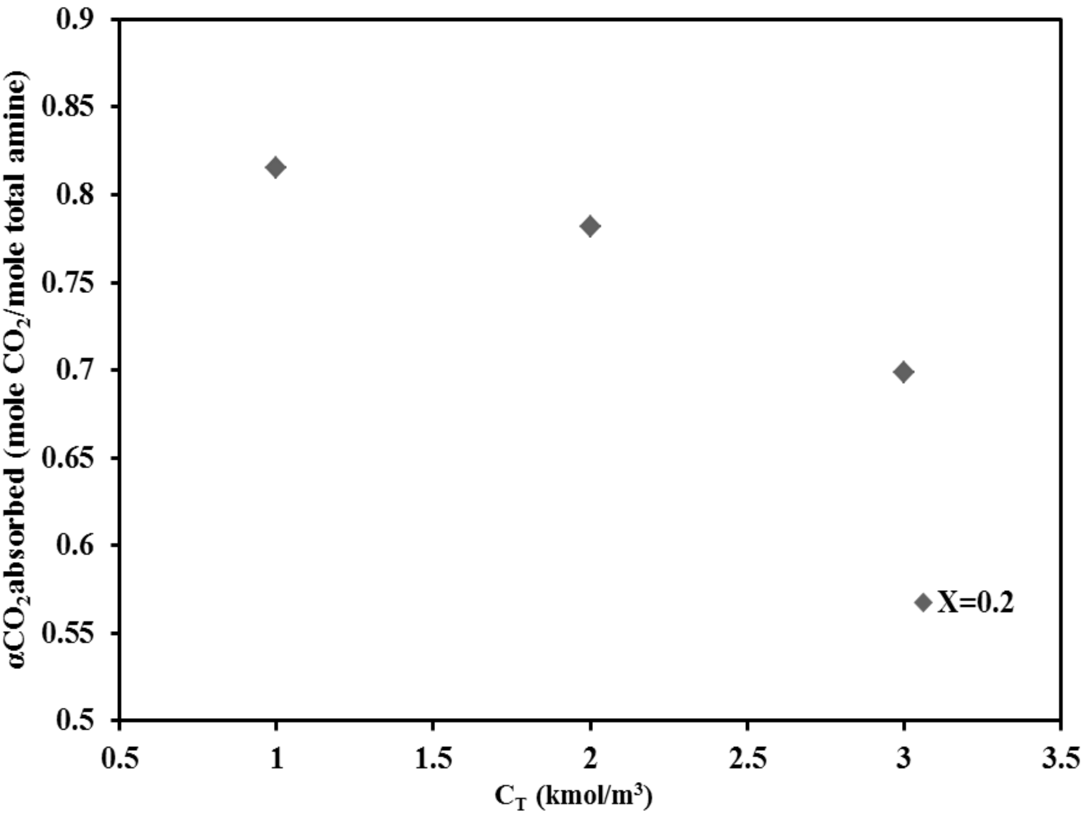

Figure 4.4 CO_2 solubility α_{CO_2} with different total amine concentration C_T at T 313.15 K and pCO_2 20.265 kPa, for X 0.2

4.3.1.2 Effect of partial pressure

The CO_2 partial pressure in inlet gas stream conjointly plays a serious role in acidic gas absorption. Its impact on the CO_2 solubility was studied in an exceedingly 2.0 kmol/m^3 DEEA + AEEA blend with an AEEA mole fraction of 0.20 at 313.15 K for CO_2 partial pressures vary of 10.199-20.265 kPa. From figure 4.5, it is clearly seen that the CO_2 partial pressure incorporates a little result on CO_2 solubility between the variation of 10.199-12.63 kPa and 17.732-20.265 kPa. The CO_2 solubility increases from (0.48 to 0.78) mol of CO_2 per mole of total amine blend as the CO_2 partial pressure increases from (10.133 to 20.265) kPa.

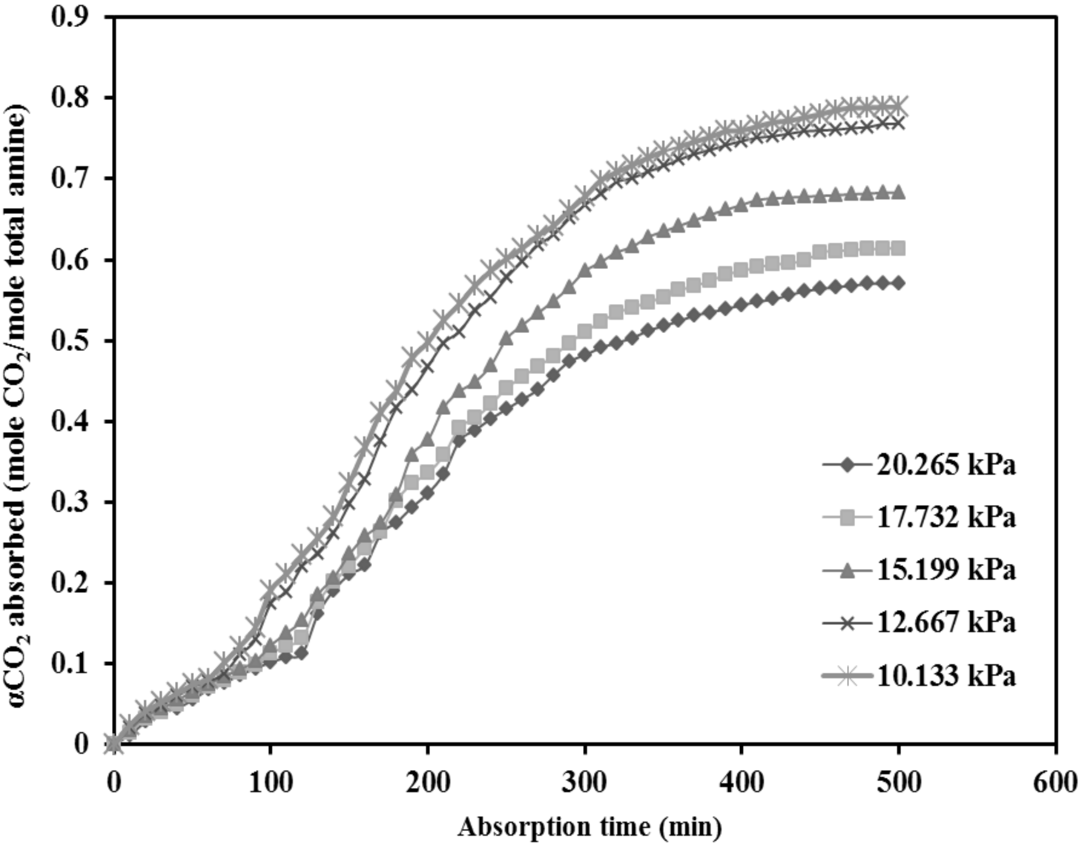

Figure 4.5 Variation of the CO_2 solubility α_{CO_2} with absorption time at various inlet partial pressure of CO_2 in a 2 kmol/m^3 amine blend with AEEA mole fraction in total amine of 0.2

Figure 4.6 shows that the acidic gas CO_2 solubility increases with increasing CO_2 partial pressure in the inlet gas stream as a result of increasing gas-phase mass transfer due to the rise of driving force exist in the gas phase from bulk to the gas-liquid interface.

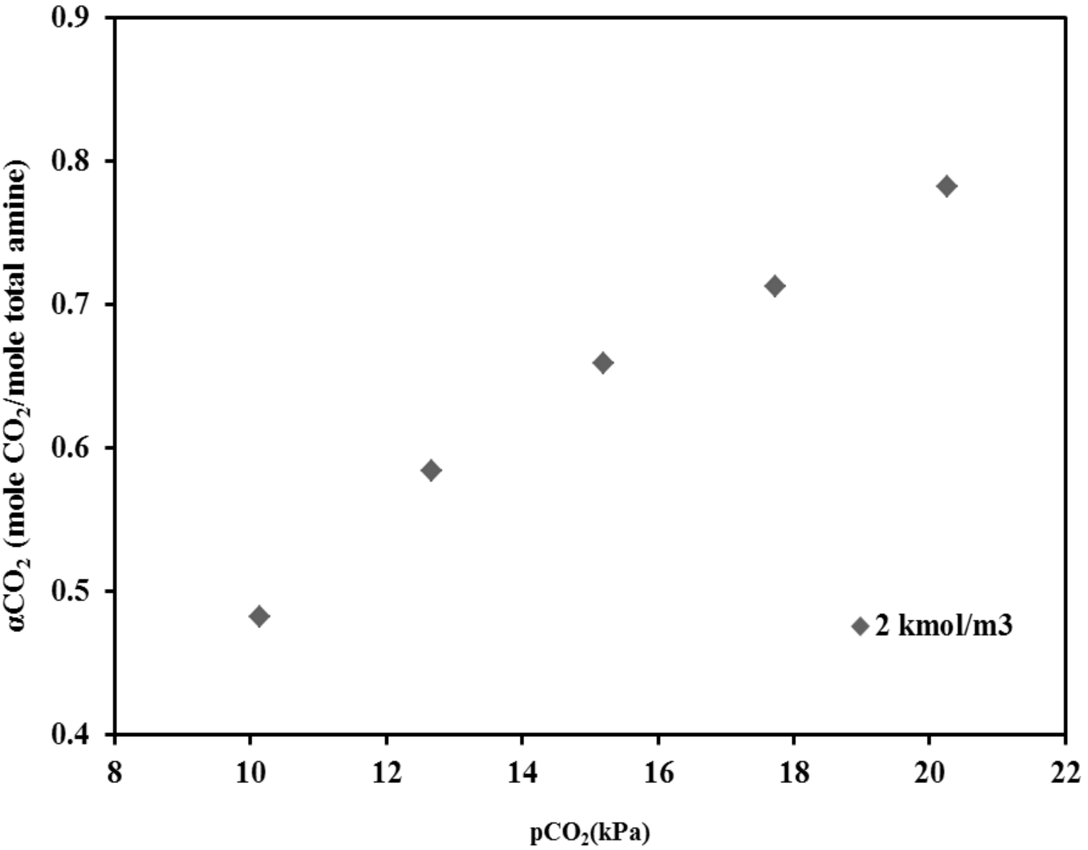

Figure 4.6 CO_2 solubility α_{CO_2} with partial pressure of CO_2 at T 313.15K in 2 kmol/m^3 amine blend with AEEA mole fraction in total amine of 0.2

4.3.1.3 Effect of temperature

Figure 4.7 shows the influence of temperature on CO_2 solubility in DEEA+AEEA blend over the temperature range (303.15 to 333.15) K. In this regards, CO_2 partial pressure in the gas stream, total blend concentration, and AEEA mole fraction within the blend were 20.265 kPa, 2.0 kmol/m^3, and 0.2, respectively. From figures 4.7 and 4.8, the solubility of CO_2 decreases with increasing temperature, in agreement with information reported by Kundu and Bandyopadhyay (2006) and Mondal (2009).

The reactions between CO_2 and amines in absorption process are reversible in nature and as the temperature is increased then gas-liquid equilibrium shifted in the backward direction. Also, at higher temperatures, naturally desorption of CO_2 takes place, and the solubility of acidic gases typically decreases with increasing temperature.

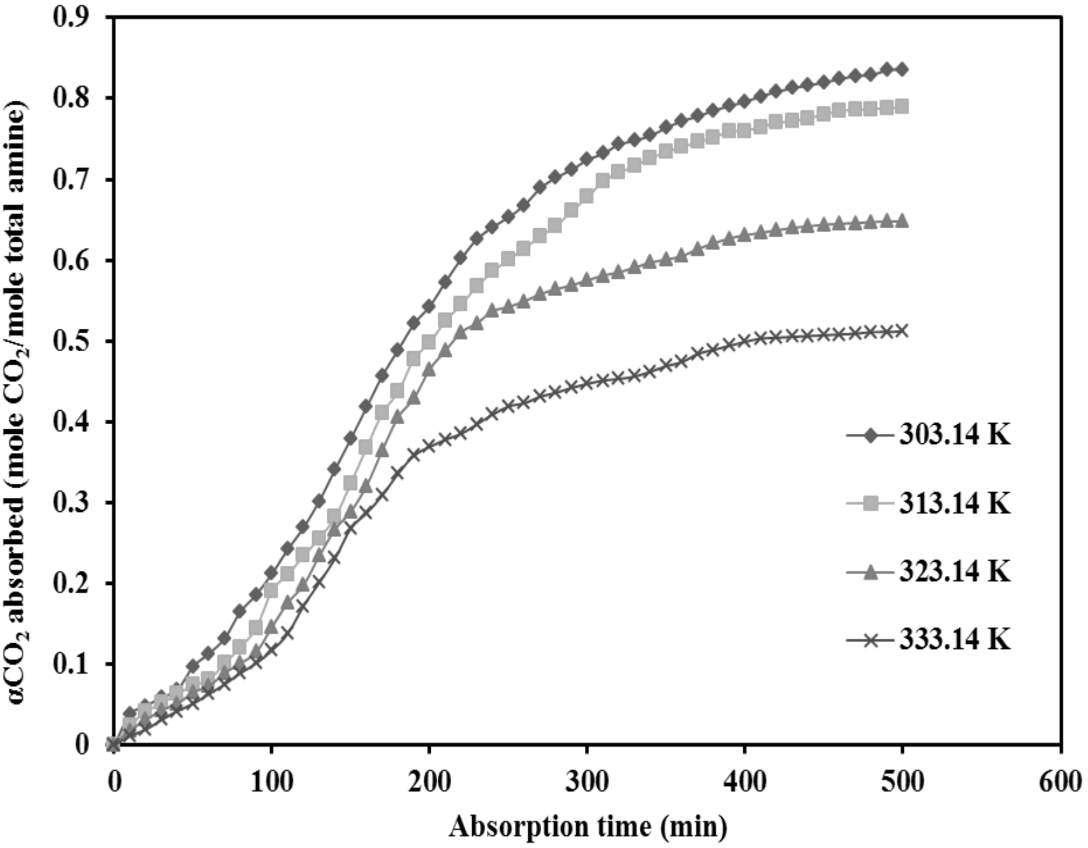

Figure 4.7 Variation of the CO_2 solubility α_{CO_2} with absorption time at various temperatures T (K) in a 2 kmol/m^3 amine blend having AEEA mole fraction in total amine of 0.2

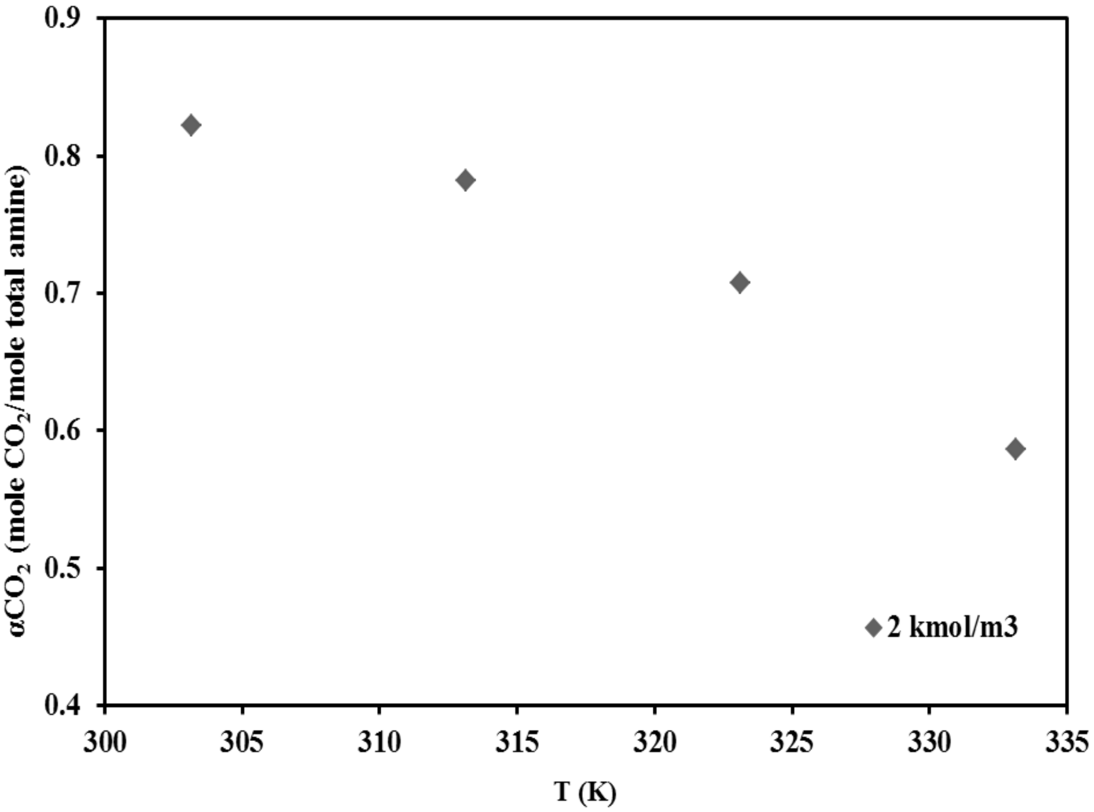

Figure 4.8 CO_2 solubility α_{CO_2} with temperature in 2 kmol/m^3 amine blend having AEEA mole fraction of 0.2 at 20.265 kPa

4.3.1.4 Comparison of CO_2 solubility data in various aqueous mixtures of amines

Maximum CO_2 solubility according to numerous authors for various amine blends are given in table 4.2. It has been observed that the present amine blend as a mixture of DEEA and AEEA have a higher solubility value than the other amine blend within the literature.

Table 4.2 Comparison of CO_2 solubility data in various aqueous mixtures of amines with respect to DEEA+AEEA blend

Amine mixture	Operating conditions			α_{CO2} (mol CO_2/mol total amine)	References
	C_T (kmol/m^3)	$T(K)$	p_{CO2} (kPa)		
DEEA+AEEA	1	303	20.27	0.843	This work
DEEA+AEEA	1	313	20.27	0.815	This work
DEEA	2.5	313	20	0.457	Luo et al., 2016b
DEEA+MEA	2.5	313	20	0.531	Luo et al., 2016b
DEEA+PZ	2.5	303	5.80	0.69	Sutar et al., 2013
DEA+AEEA	2	303	20.27	0.74	Bajpai and Mondal, 2013
MDEA+DEA	2	313	20.00	0.696	Kundu and Bandyopadhyay, 2006
MDEA+PZ	2	313	15.20	0.75	Ali and Aroua, 2004
MDEA+MAPA	-	313	-	0.743	Arshad et al., 2014

4.3.2 Development of CO_2 solubility model

After, the equilibrium solubility data obtained from present experimental results, an empirical solubility model was developed as a function of total concentration of amine blend, mole fraction of AEEA in total amine blend, CO_2 partial pressure in inlet gas stream and temperature of amine blend. A function of the following form was tried to develop the CO_2 solubility model in an aqueous blend of DEEA and AEEA.

$$\alpha = C_1 + C_2 * X + C_3 * C_T + C_4 * T + C_5 * p_{CO_2} + C_6 * X^2 + C_7 * C_T{}^2 + C_8 * T^2 + C_9 * p_{CO_2}{}^2 \quad (4.1)$$

Where, C_T is total concentration of amine blend in kmol/m^3, X is mole fraction of AEEA in total amine blend, T is temperature of amine blend in K, and p_{CO2} is inlet partial pressure of CO_2 in gas stream in kPa. Then, the equation 4.1 in matrix form was solved as given below:

$$\begin{pmatrix} C_{11} & C_{12} & C_{13} & C_{14} & C_{15} & C_{16} & C_{17} & C_{18} & C_{19} \\ C_{21} & C_{22} & C_{23} & C_{24} & C_{25} & C_{26} & C_{27} & C_{28} & C_{29} \\ C_{31} & C_{32} & C_{33} & C_{34} & C_{35} & C_{36} & C_{37} & C_{38} & C_{39} \\ C_{41} & C_{42} & C_{43} & C_{44} & C_{45} & C_{46} & C_{47} & C_{48} & C_{49} \\ C_{51} & C_{52} & C_{53} & C_{54} & C_{55} & C_{56} & C_{57} & C_{58} & C_{59} \\ C_{61} & C_{62} & C_{63} & C_{64} & C_{65} & C_{66} & C_{67} & C_{68} & C_{69} \\ C_{71} & C_{72} & C_{73} & C_{74} & C_{75} & C_{76} & C_{77} & C_{78} & C_{79} \\ C_{81} & C_{82} & C_{83} & C_{84} & C_{85} & C_{86} & C_{87} & C_{88} & C_{89} \\ C_{91} & C_{92} & C_{93} & C_{94} & C_{95} & C_{96} & C_{97} & C_{98} & C_{99} \end{pmatrix} \times \begin{pmatrix} 1 \\ X \\ C_T \\ T \\ p_{CO_2} \\ X^2 \\ C_T{}^2 \\ T^2 \\ p_{CO_2}{}^2 \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \\ \alpha_8 \\ \alpha_9 \end{pmatrix}$$

The above matrix form may be written as

$[C]\,[Z] = [\alpha]$

Or $[C] = [Z]^{-1}\,[\alpha]$ (4.2)

After solving the matrix in MATLAB, the fitting constants were obtained. These constants are:

$C_1 = 0.01163$ mol CO_2 mol amine^{-1}, $C_2 = 3.2\times10^{-2}$ mol CO_2 mol amine^{-1} m^3 kmol^{-1},

$C_3 = 3.1\times10^{-5}$ mol CO_2 mol amine^{-1}, $C_4 = 4.1\times10^{-5}$ mol CO_2 mol amine^{-1}kPa^{-1},

$C_5 = 3.2\times10^{-4}$ mol CO_2 mol amine^{-1} K^{-1}, $C_6 = 1.4\times10^{-3}$ mol CO_2 mol amine^{-1} m^6 kmol^{-2}

$C_7 = 3.8\times10^{-4}$ mol CO_2 mol amine^{-1}, $C_8 = 4.7\times10^{-6}$ mol CO_2 mol amine^{-1} kPa^{-2}

$C_9 = 3\times10^{-6}$ mol CO_2 mol amine^{-1} K^{-2}

The calculated values of modeling results were plotted against experimental results as shown in figure 4.9. The R^2 value obtained from modeling result is equal to 0.992. However, the developed CO_2 solubility model is valid for total amine blend concentration in range of 1-3 kmol/m^3, AEEA mole fraction in total amine blend in ranges of 0.02-0.20, CO_2 partial pressure in range of 10.132-20.265 kPa and amine blend temperature in range of 303.15-333.15 K.

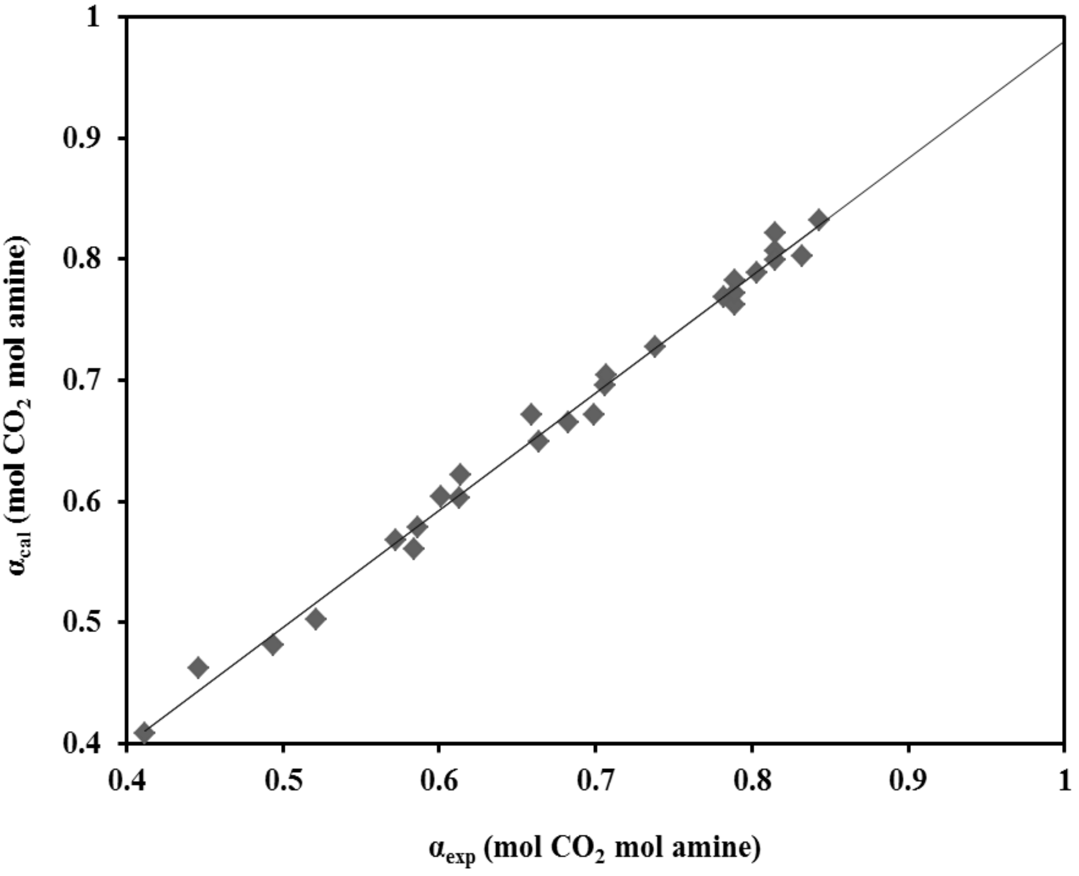

Figure 4.9 Plot between calculated (α_{cal})and experimental CO_2 solubility (α_{exp}) for DEEA+AEEA blend

4.4 CONCLUSIONS

The amount of CO_2 absorbed varies with absorption time, it show similar nature of plot with all operating parameters such AEEA mole fraction in total amine, amine blend concentration, CO_2 partial pressure, and temperature. At initial stage, absorption of CO_2 takes place very rapidly within 0 to 120 min, and then becomes very low leading to the formation of carbonated saturated solution to achieve gas-liquid equilibrium. Further, more and more dissolution of CO_2 in the blend takes place due to the presence of two amino groups in AEEA, it enhanced the CO_2 absorption corresponding to a higher CO_2 loading. Maximum solubility of CO_2 in amine blend is observed at a 0.2 of AEEA mole fraction in total amine. The total time elapsed to achieve at equilibrium is varies from 480 to 600 min depending on concentration of amine blend and operating parameters. The solubility of CO_2 in DEEA+AEEA blend increases with increasing concentration of CO_2 in gas phase but, decreases as temperature rises. Also, the CO_2 solubility in present blend is more than the other published data in the field. The developed empirical solubility model exhibits a good relationship with experimental data for all operating variables. So, the present amine blend is more feasible and potential for the removal of CO_2 from flue gas emitted from coal-fired thermal power plant.