LITERATURE REVIEW AND OBJECTIVES

Many investigations have been made regarding the amine-based solvent used for the CO_2 capture applications. In the amine-based absorption process, a gas mixture is in contact with liquid solvent (absorbent) for the purpose of preferentially dissolving one or more components of the gas mixture followed by chemical reactions. Use of the aqueous solution of amines and mixture of two or more amines are quite popular for CO_2 absorption. In this regard, the tertiary amine, N, N-Diethyl ethanol amine (DEEA), and DEEA-based amine blend were widely studied by the various researchers for CO_2 removal from various gas streams. Therefore, it is necessary to review the previous works related to aqueous solution of novel tertiary amine, DEEA, and DEEA-based amine blends for CO_2 capture applications. The brief summaries of all CO_2 related screening works with the above mentioned amine and amine blends are discussed in this chapter.

2.1 Amine-based solvent for CO_2 capture

In this literature reviews, we have emphasized on the research works related to amine-based solvents for CO_2 capture. The amine-based absorption technology has been widely used in the CO_2 capture because it possesses good removal efficiency up to 90%, capable of removing CO_2 up to low concentration from the gas stream, handling an enormous amount of emitted gas streams, cost-effectiveness, retrofitting option, and solvent regeneration option (Ciferno et al., 2009; Rao and Rubin, 2002; Xu et al., 2016). The amine-based solvents such as alkanolamine and diamine have been used for removal of CO_2 from different gas streams such as flue gas, natural gas, blast furnace off-gas, etc.

The different types of alkanolamines such as primary amine monoethanolamine (MEA), secondary amine diethanolamine (DEA), tertiary amine N-methyl diethanolamine (MDEA), sterically-hindered amine 2-amino-2-methyl-1-propanol (AMP); and diamines such as piperazine (PZ) are commonly used in the CO_2 capture process. Among these, MEA is widely used in the CO_2 capture process because of its fast reaction/absorption rate, limited CO_2 absorption capacity, and low material cost (Kohl and Nielsen, 1997). But, it requires high energy for solvent regeneration and contributes to approximately 70-80% of operating cost applied in the capture process (Feng et al., 2010). So, for improving the CO_2 capture performance, researchers have attracted to develop an alternative novel single amine solvent. For the selection of novel single amine solvent for CO_2 capture, researchers have more focused on tertiary amine solvent because it requires less energy for solvent regeneration as compared to a single primary, secondary and diamines solvent. Therefore, researchers performed extensive screening works to search novel tertiary amine solvent which applied in the CO_2 capture applications. Screening study is the primary step for the selection of any solvent considered for the CO_2 capture process. So, in the next section, available recent literatures related to screening of tertiary amines for CO_2 capture have been discussed in details.

2.2 Screening of tertiary amine-based solvent for CO_2 capture

Chowdhury et al. (2009) performed different experiments at a laboratory scale to select promising amine solvent for CO_2 capture among twenty-five tertiary amines with different structures. The performance of all the entire amines was measured by using the screening test apparatus, vapor-liquid equilibrium (VLE) apparatus and differential reaction calorimeter. The amine solvent performances were evaluated in terms of absorption rate, absorption amount, absorption capacity, vapor-liquid equilibrium

property (CO_2 loading capacities) and their performances were compared with standard tertiary amine MDEA. The results showed that thirteen amine absorbents were promising for CO_2 capture because its performance in terms of absorption rates and heat of absorption were better than MDEA. They also depicted that methyl and ethyl group present in the amine structure showed a positive effect to enhance the absorption capacity and initial absorption rate but decreased the heat of absorption. The effect of the hydroxyl group present in the amine structure on the CO_2 loading and absorption rate was also observed and increasing this group in the chemical structure had a negative effect.

Twenty-four tertiary amines including three synthetic tertiary amines with different structure were also further investigated by Chowdhury et al. (2013) for the evaluation of CO_2 capture performance. The experiments were performed by using different experimental apparatus as gas scrubbing test, VLE apparatus, and reaction calorimeter at various operating conditions for the desired concentration of amine solution. The capture performance of entire alkanolamines was evaluated in terms of CO_2 loading, absorption rate, cyclic capacity and heat of reaction. The performances of all the studied alkanolamines were compared with the performance of conventional tertiary amine MDEA. Among these, seven high performing amine solvent were found with high cyclic capacities and absorption rate as those of standard amine MDEA and lower heat of reaction. Further, the high performing amines were tested using VLE apparatus to evaluate CO_2 loading at the temperature range of 40-120 °C and 20 kPa CO_2 partial pressure. Finally, the efficient amine solvent for CO_2 capture process was selected based on performance which showed fast absorption rate, high cyclic capacity and low heat of reaction.

In a study, Nouacer et al. (2014) measured the CO_2 solubility in aqueous solution of different tertiary amines such as 3-dimethyl amino-1-propanol (DMAP-31), 2-(2-

(dimethylamino) ethoxy) ethanol (DMAEOE), 1,2-bis (dimethyl amino) ethane (TEMED), methyl-4-morpholine and pyridine using static method for a fixed concentration of 2.5 M. The density and vapour pressure of aqueous solution of all amines were also measured by using picynometry and static method, respectively. They showed that CO_2 solubility in the entire investigated amine solution decreased with increasing temperature and increased with the increase of the CO_2 partial pressure. The solubility of CO_2 in aqueous solution follows the order of DMAP-31 > TEMED > DMAEOE > Methyl morpholine > Pyridine.

Another study investigated by Liu et al. (2016c) for three aqueous solutions of tertiary amine such as 1-(2-hydroxyethyl)pyrrolidine (1-(2-HE)PRLD), 1-(2-hydroxyethyl)-piperidine (1-(2-HE)PP), and 3-diethylamino-1,2-propanediol (DE-1,2-PD) to evaluate the CO_2 absorption performance in terms of reaction rate constant, protonation constant and absorption heat. The CO_2 absorption kinetics was performed by using stopped-flow technique and kinetic data was analyzed using a base-catalyzed hydration mechanism and artificial neural network (ANN) models. A Brønsted plots between protonation constant (K_1) and reaction rate constant (k_2) were recognized to know the relationship between protonation constant and kinetics. The absorption heats of CO_2 for all the amines were calculated by using the Gibbs-Helmholtz equation. The results of absorption kinetics and absorption heat were also compared with tertiary amines MDEA and DMAP-31 as well as conventional primary amine MEA. The absorption kinetics of amine follows as: MEA > DEA > DEAB > DE-1,2-PD > 1-(2-HE)PRLD > 1-(2-HE)PP > DMEA > 1DMA2P > MDEA and CO_2 absorption heat follows in the order of MEA > DEA > MDEA > DEAB > DE-1,2-PD >1-(2-HE)PRLD > 1-(2HE)PP > 1DMA2P.

Singto et al. (2016) investigated five new aqueous solutions of synthesized tertiary amines such as 4-(dipropylamino)-2-butanol (DPAB), 4-(dimethylamino)-2-butanol (DMAB), 4 (dibutylamino)-2-butanol(DBAB), 4-((2 hydroxyethyl)(ethyl)amino)-2-butanol (HEEAB) and 4-((2 hydroxyethyl)(methyl)amino)-2-butanol (HEMAB) to evaluate the performance in terms of CO_2 equilibrium solubility, cyclic capacity, absorption rate, regeneration rate, amine dissociation constant, CO_2 absorption heat and heat required for solvent regeneration. Amine-structure property relationships were also evaluated. The CO_2 equilibrium solubility and cyclic capacity of CO_2 were measured by experimental apparatus consisting of saturation cell connected with the reactor. The absorption and regeneration rate were measured using a simplified absorption-desorption setup. The amine dissociation constant and CO_2 absorption heat were evaluated by using pH meter and Gibbs-Helmholtz equation, respectively. After the comparison of investigated amine solvent based on outstanding performance, three amines such as DMAB, HEMAB and HEEAB were considered as a promising solvent for CO_2 capture.

Further, more researchers (Xiao et al., 2016, 2018; Liu et al., 2017a,b, 2019; 2019a, Garcia-Abuin et al., 2017; Balter et al., 2019) performed screening studies for the selection of efficient alternative tertiary amine for CO_2 capture.

The above-investigated novel tertiary amine solvent, measurement method, absorption-desorption performance parameter and operating conditions used during experimental/theoretical investigations have also been summarized in table 2.1.

Table 2.1 Tertiary amine-based solvent for CO_2 capture

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial (kPa)
Chowdhury et al., 2009	25-Tertiary amines	Absorption capacity, CO_2 solubility absorption rate, cyclic capacity, absorption heat	Screening test, VLE-test, DRC, TOC	30 mass %	313-393	20.27
Chowdhury et al., 2013	24-Tertiary amines	Ion speciation, CO_2 solubility, absorption rate, cyclic capacity, absorption heat	Gas scrubbing system, VLE-apparatus, Reaction calorimeter, GC, LC-MS, NMR, TOC	30 mass %	313-393	20.27
Nouacer et al., 2014	DMAEOE, DMAP-31, TEMED, Pyridine, Methyl morpholine	CO_2 solubility, vapour-pessure, density	Equilibrium cell, Static method, Picnometry	2.5 M	313, 353	0-200
Singto et al., 2016	MDEA, DEAB, DMAB, DPAB, DBAB, HEMAB, HEEAB	CO_2 loading cyclic capacity, synthesis, ion species analysis absorption-desorption rate, absorption heat,	Screening-apparatus, VLE-apparatus, PH Meter, Gibbs-Helmotz equation	2 M	298-353	3-100

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Xiao et al., 2016	10-Tertiary amine	CO_2 solubility, absorption-desorption rate, cyclic capacity, absorption heat, acid dissociation constant, amine structure activity relationship	VLE-apparatus, Clausius-Clapeyron equation, Chittick-apparatus	2 M	298-313	8.1-60.8
Liu et al., 2016c	DE-1,2-PD; 1-(2-HE)PRLD, 1-(2-HE)PP	Kinetics parameter, absorption heat, enthalpy, entropy, activation energy, Protonation constant,	Stopped-flow apparatus, VLE-apparatus, ANN model	0.1-1.0 M (for kinetics study)	298-313	8-101
Garcia-Abuin et al., 2017	DEEA, DMEA, MDEA, TIPA	Absorption rate, reaction mechanism, viscosity, surface tension	Bubbling reactor, NMR	Not available	Not available	Not available
Stowea and Hwang, 2017	DEEA, AMP	ions species analysis	AIMD-simulation, DFT	Not available	Not available	Not available

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Liu et al., 2017a	7-Tertiary amines	CO_2 solubility	VLE-apparatus, Modeling	2 M	298-313	3-101.3
Liu et al., 2017b	1-(2-HE)PRLD	Reaction rate constant, absorption heat,	Stopped-flow apparatus, VLE-apparatus	2 M (SL), 0.20-1 M	293-313	Not available
Xiao et al., 2018	TEA, MDEA, DMEA, DMAP-31, DEEA	CO_2 solubility, reaction rate constant, absorption heat	VLE-apparatus, Clausius-Clapeyron equation, Chittick-apparatus, M-KE-model	2 M	298.15-313.15	8.1-60.8
Liu et al., 2019	4-Tertiary amines	Gibbs free energy change, molar reaction enthalpy, cyclic capacity	Screening apparatus, VLE-apparatus, Rate-based screening method	2.5 M	293-313	15
Liu et al., 2019a	7-Tertiary amine	CO_2 solubility, reaction rate constant,	(KE, Austgen, Helei-Liu, Hu-Chakma, Li-Shen, Liu et al., ANN) model	2M	298-333	3-101
Baltar et al., 2019	DEEA, DMEA	CO_2 solubility, absorption rate, regeneration cycle	Absorption-desorption setup	0.1-1 M	295, 373	Not available

After the detailed reviews of above literatures related to screening of tertiary amine solvent for CO_2 capture, it was observed that the numbers of novel tertiary amines were shown promising results for CO_2 capture and they showed better capture performance than common tertiary amine MDEA. But, among these novel tertiary amines, aqueous solution of DEEA is considered as a potential solvent for CO_2 capture. So, researchers (Monteiro et al., 2013; Arshad et al., 2014a; Gao et al., 2015; Garcia et al., 2016; Luo et al., 2016; Xu et al., 2016; Xiao et al., 2016, 2018; Garcia-Abuin et al., 2017; Stowea and Hwang, 2017) carried out extensive works on DEEA solvent to evaluate its performances in terms of CO_2 loading, absorption-desorption rate, cyclic capacity, regeneration efficiency, VLE modeling, absorption heat, volumetric overall mass transfer coefficient, etc. The summaries of the above literatures have also been presented in table 2.2. Also, it has a unique advantage that DEEA can be prepared from renewable sources like agricultural residue or waste products and it could reduce the material cost to be beneficial from industrial point of view (Vaidya and Kenig, 2007).

Table 2.2 DEEA solvent for CO_2 capture

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Monteiro et al., 2013	DEEA	CO_2 solubility	VLE-apparatus, e-NRTL model	2, 5 M	313, 393	0-1000
Arshad et al., 2014a	DEEA	CO_2 solubility, heat of reaction	Equilibrium cell, Calorimeter	DEEA: 5M, and MEA: 30 mass %	313, 353, 393	Total Pressure: 0-1500
Xu et al., 2014	DEEA	CO_2 solubility, absorption heat	Equilibrium cell, Calorimeter, e-NRTL model	3, 4 M	333, 353	3-192
Gao et al., 2015	DEEA	Absorption-desorption rate, overall mass transfer coefficient	Screening apparatus	30 wt.%	313.15, 353.15	0-25
Xu et al., 2016	DEEA	Mass transfer coefficient	Packed column	3 M	313.15	15
Luo et al., 2016	DEEA	CO_2 solubility	VLE-setup, (KE, e-NRTL, UNIQUAC) model	1-4 M	293-353	6.2-100.8
Garcia et al., 2016	DEEA	CO_2 solubility, density	e-NRTL model, Aspen	2, 5 M	313-393	Not available

But, DEEA has low CO_2 absorption rate because it does not directly react with CO_2 owing to the inherent characteristics of a tertiary amine (Jiang et al., 2018). In order to obtain DEEA with both fast absorption rate and low regeneration energy consumption, the concept of mixture of amine as an amine blend becomes more and more attractive. In this type of amine blend, one component has higher absorption capacity as well as low regeneration energy and another component has higher absorption rate (Chakravarty et al. (1985)). So, on the basis of this amine blend concept, different researchers (Conway et al., 2015; Fu et al., 2016b; Gao et al., 2017; Liao et al., 2017; Li et al., 2018; Chen et al., 2019) used activator as primary or secondary monoamine solvent to improve performance of single DEEA solvent. But recently, polyamine type solvent as an activator has more efficient than monoamine type solvent because polyamine solvent contains multiple amino groups in its chemical structure so it provides extra reaction sites which corresponds to more absorption of CO_2 in polyamine (Ma'mun et al., 2007a,b). Among this polyamine solvent, diamines has more widespread than triamine (DETA), tetramines (TETA), pentaamine (TEPA) type solvent because diamines are not readily lost by thermal/oxidative degradation, corrosion, evaporation during the absorption-desorption process (Gao et al, 2017).

Therefore, attention is being more focused on DEEA-based amine blends which can combine the favorable features of fast reacting diamines solvent and DEEA. The DEEA with diamines can be realized as economically attractive absorbents for CO_2 capture. The available literatures on aqueous amine blend particularly as a mixture of DEEA and different diamines for CO_2 capture have been systematically discussed in next section.

2.3 Screening of DEEA-based amine blend solvent for CO_2 capture

Vaidya and Kenig (2009) studied the kinetics of the reaction of CO_2 with two aqueous blends of DEEA+EAE and DEEA+PZ by using stirred cell reactor. They found that the presence of EAE and PZ accelerates the DEEA reaction with CO_2. They also showed that PZ is more effective diamine activator than EAE to improve the kinetic performance of DEEA with CO_2. Therefore, aqueous blend of DEEA and PZ can be considered as a potential absorbent for the removal of CO_2 from gas stream.

Further PZ activator was also used by various researchers (Konduru et al., 2010; Sutar et al., 2013; Fu et al., 2016a; Adak and Kundu, 2017; Gao et al., 2018; Afkhamipour et al., 2019) to improve the DEEA performance for CO_2 capture.

Konduru et al. (2010) performed experiment by using stirred cell reactor to investigate equilibrium and kinetics characteristics of the CO_2 reaction with aqueous mixture of DEEA and PZ. They showed that, reaction system (DEEA+PZ+CO_2) belongs to the fast pseudo-first-order reaction regime and value of second-order rate constant was found to be 24,450 m^3/kmol.s at 303 K.

Sutar et al. (2013) used three diamine promoters PZ, AEEA, HMDA to make DEEA-blends for improving the performance of DEEA for CO_2 capture. They showed that HMDA is most effective promoter among three to enhance the kinetic characteristics of the reaction system. The equilibrium characteristic of DEEA+PZ system was also evaluated. Fu et al. (2016a), Adak and Kundu (2017), Afkhamipour et al. (2019) measured the CO_2 solubility in DEEA+PZ solution using VLE-apparatus at various conditions and its details are reported in table 2.3. Fu et al. (2016a) also measured viscosity of unloaded and CO_2 loaded blend solution, they showed that viscosity increased with the increase of PZ and DEEA concentration and decreased with the

increase of temperature. Adak and Kundu (2017) also reported the viscosity and density data of DEEA+PZ solution.

The generated viscosity and density data using correlations may be useful for the engineering design of gas treating equipment.

Also, diamines activator MAPA was used by various researchers (Hartono et al., 2013; Arshad et al., 2014b; Arshad et al., 2016; Rahimi et al., 2019) to improve the DEEA performance for CO_2 capture and details are reported in table 2.3

Gao et al., (2016) investigated different amine blends as composed of DEEA and nine activators including, MEA, DEA, AMP, EAE, PZ, AEEA, MAPA, DETA, TETA for CO_2 capture by using fast screening method. The performances of all the entire proposed amine blends were evaluated in terms of absorption capacity, absorption rate, desorption capacity, desorption rate, and cyclic capacity. The results showed that, addition of activator in DEEA solution improved its performance. Also, performance of DEEA-based blend is better than single DEEA absorbent and conventional absorbent MEA. Among these blends, DEEA+PZ is the most promising absorbent for CO_2 capture.

Further, Gao et al. (2017) studied the absorption-desorption performance of CO_2 in various amine blends as a mixture of MEA and different tertiary amine as DEEA, MDEA, DMEA, DMAP-12 DEAP-12, DMAP-31, 2DMA2M1P, TEA, 3DMA-1,2-PD, and 3DEA-1,2-PD). The performances of entire amine blends were evaluated in terms of absorption capacity, absorption rate, desorption capacity, desorption rate and cyclic capacity by using multiple rapid screening method and compared with MEA. Among these amine blends, DMAP-12+MEA is considered as most promising absorbent for CO_2 capture.

Above all mentioned DEEA-based amine blends used in the literature can also be tabulated and their summaries are presented in table 2.3.

Table 2.3 DEEA-based amine blend solvent for CO_2 capture

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Vaidya and Kenig, 2009	DEEA+EAE, PZ	Kinetic performance parameter	Stirred cell reactor	DEEA: 1.5-2.5 M; EAE, PZ: 0.1 M	298-308	4-17
Konduru et al., 2010	DEEA+PZ	Kinetic performance parameter	Stirred cell reactor	DEEA+PZ: 2.1-2.5 M	298-308	Not available
Hartono et al., 2013	DEEA+MAPA	CO_2 solubility	UNIQUAC-activity coefficient model	DEEA+MAPA: 1M+2M	313-393	Not available
Sutar et al., 2013	DEEA+PZ, AEEA, HMDA	Kinetics characteristics, CO_2 loading capacity	Stirred cell reactor	DEEA: 2.5M, Activator: 0.1-0.5 M	303	5.8
Arshad et al., 2014b	DEEA+MAPA	CO_2 solubility, heat of reaction	Calorimeter	DEEA: 5M; MAPA: 1-2 M	313, 353, 393	Total pressure: 0-1500
Conway et al., 2015	DEEA, DMEA, AMP+MEA	Absorption flux, density, viscosity, mass transfer co-efficient, cyclic capacity, absorption capacity	WWC, VLE, MATLAB	Blend: 4-6 M; MEA: 2-3M	313-373	1.0-20.0

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Arshad et al., 2016	DEEA+MAPA	CO_2 solubility	UNIQUAC-model	DEEA+MAPA: 5M+2M	313.15,353.15, 393.15	Total pressure: 0-1500
Fu et al., 2016a	DEEA+PZ	CO_2 solubility, viscosity	Stirred cell reactor	DEEA: 30-50 wt%; PZ: 0-7.5 wt%	303.15-323.15	Not available
Fu et al., 2016b	DEEA+MEA	CO_2 solubility, viscosity	Stirred cell reactor	DEEA: 30,40 wt%; MEA: 0-15 wt.%	303.2-323.2	Not available
Gao et al., 2016	DEEA+MEA, DEA, EEA, AMP, AEEA, MAPA, DETA, TETA, PZ	CO_2 loading capacity, absorption-desorption rate, cyclic capacity	Screening setup, VLE-setup, Chittick apparatus	DEEA: 2M, Activator: 1M	313.15, 353.15	15
Adak and Kundu, 2017	DEEA+PZ	CO_2 solubility, viscosity, density	VLE-apparatus, M-KE model	DEEA+PZ: 1.15, 2.6, 4.67, 3.68, 7.45 mol/kg	303.15-323.15	0.1-65
Budhwani et al., 2017	DEEA, EDEA+ EDA, EAE	Vapor-liquid equilibrium data, kinetic performance	Stirred cell reactor, Equilibrium cell	DEEA, EDEA: 2, 2.5 M; EDA, EAE: 0.1-0.5 M	308	Not available
Gao et al., 2017	DEEA, DMEA, DMAP-12, DMAP-31, DEAP-12+ MEA	CO_2 loading capacity, absorption-desorption rate, cyclic capacity	Rapid screening apparatus, VLE-setup, Chittick apparatus	Tertiary amine: 1M; MEA: 5M	313.15, 353.15	15
Kruszczak and Pawlak, 2017	DEEA+AMP, AMPD, MAPA	Kinetics characteristics	Calorimeter	DEEA: 1.5,1.8 M; AMPD, AMP: 0.5 M	303-333	Not available

Author	Absorbent	Performance parameter	Apparatus/model	Total or activator concentration	Temperature (K)	CO_2 partial pressure (kPa)
Gao et al.,2018	DEEA+PZ	Absorption-desorption rate, cyclic capacity, mass transfer coefficient	Screening apparatus, Hollow fiber membrane contactor	DEEA(M)+PZ(M): 2+0, 1.5+0.5, 1+1, 0.75+1.25, 0.5+1.5, 0.25+1.75, 0+2	313.15, 353.15	10-20
Li et al., 2018	DEEA+AMP	CO_2 solubility	Absorption setup	DEEA: 30-40 wt %; AMP: 0-15 wt %	303.2-323.2	101.13
Afkhamipour et al., 2019	DEEA+PZ	CO_2 solubility	DM-model	PZ:0.2-4.5 M	298-328	0.1-1500
Chen et al., 2019	DEEA, DMEA+MEA	Kinetics characteristics	Stopped-flow method	DEEA, DMEA: 0.2-0.4 M	293-313	Not available
Rahimi et al., 2019	MDEA, DMEA, DEEA+AEEA, MAPA	CO_2 solubility, density, viscosity	Autoclave reactor, pycnometer, viscometer	Tertiary: 40 wt%, Diamine: 5 wt%	303.15-353.15	5-500

2.4 Scope of present research work / Research Gap

From the literature reviews, it has been observed that DEEA is tertiary amine alternative to common tertiary amine MDEA and its performance is better than MDEA because of its high CO_2 absorption capacity, low heat of absorption, easily recovered after desorption, less corrosive towards the material of construction of the equipment. Moreover, it can be prepared from renewable resources and hence is quite environment-friendly and also having low material cost. Therefore, it is extensively used in the blends such as DEEA+MEA, DEEA+PZ, DEEA+MAPA, DEEA+BDA etc. There are very few studies available on EDA, AEEA, HMDA, and DMAPA with DEEA as prime amine for CO_2 capture from low concentration of CO_2 (up to 20 kPa) in the gas streams for this applications. In view of these, the aqueous DEEA-based blend particularly as a mixture of DEEA and different types of diamines activator such as PZ, AEEA, EDA, HMDA, and DMAPA is chosen as a novel amine blend for the removal of CO_2 from gas stream containing low concentration of CO_2. The scope of this work is to select an efficient amine blend solvent based on screening studies by evaluation of different performance parameters such CO_2 solubility (loading), absorption rate, desorption rate, cyclic capacity, regeneration efficiency and heat of absorption data in selected DEEA+diamines solvent to be used in CO_2 capture from the said gas stream.

2.5 Objectives of present research work

The aim of this research work is to select an efficient amine blend as a mixture of DEEA and different diamines solvent alternative to conventional amine (MEA) solvent used in post combustion CO_2 capture for low CO_2 partial pressure applications. The evaluation of CO_2 solubility in amine solution is the prime step for selection of solvent because it is used for the evaluation of design parameter in CO_2 capture process and this solubility data are also required in the development of model. So, the present research works were aimed with the following objectives:

- To validate the experimental setup suitable for CO_2 solubility measurement.
- To perform absorption-desorption experiments for selection of suitable amine blends in regard to CO_2 capture.
- To study the CO_2 solubility in selected amine blends.
- To develop appropriate empirical CO_2 solubility models and compare the modeling results with experimental data.