Review Article on Adsorption and Removal of Carbon Dioxide from Air

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ABSTRACT:

This study aims to decrease the level of carbon dioxide from through adsorption and removal process by performing different types of techniques. Activated Carbon (AC) has been used as an adsorbent due to its environmental friendly properties and low cost. In hydrothermal treatment the performance of AC was modified using metal oxides which has large surface area and can perform high adsorption process. With the help of natural zeolite-based adsorbents in biogas the percentage of CO_2 *removal and breakthrough curve characteristic by fluctuating flow rate of air-*CO_2 *mixture and types of pellets were determined under differing temperature or conditions for this best particle size of 140 mesh pellet was found. Two commercial AC F600-900 and N.RGC30 were analysed at 303 K under flue-gas conditions in a fixed bed column which made wider micro pores due to it adsorption capacity of N.RGC30 increases and can be used for* CO_2 *adsorption and removal. Further, chemical vapour deposition (CVD) of carbon molecular prepared from GAC and CMSGAC using acetylene at various temperature, time and flow rate , this experiment results CMSGAC had high adsorption capacity and high selectivity for* CO_2 *adsorption between* CO_2 *and other GHG's ratio. Moreover, this study determines many techniques in presence of AC can be used for better performance of* CO_2 *adsorption and removal from air and can be examined through breakthrough curve, FTIR, flow rate, adsorption efficiency.*

KEYWORDS: *Adsorption, Hydrothermal Treatment, Natural zeolite-based adsorbent, F600-900 and N.RGC30, Chemical vapour deposition*

1. INTRODUCTION

Climate change has become one of the major issue it causes due to increasing amount of greenhouse gas and the major gas is carbon dioxide gas which is produced from industrial and large power station activities. CO_2 concentrations are rising due to the fossil fuels that people are burning for energy. According to NOAA`s Mauna Loa Atmospheric Baseline Observatory the amount of CO_2 rise in atmosphere with average at 414.7 parts per million in 2019. To decrease this amount of CO_2 researchers are using more technology and experiments, this studies can be efficient and cost effective. For removal of CO_2 from air adsorption process is used. Adsorption process is determined with the help of activated carbon(AC) obtained from waste materials, such as palm shells, sea mango, cocoa pod shells, rice husks and coconut trunks. One of the main technologies in reducing GHG is post combustion capture of CO_2 because it has the potential to be retrofitted to existing coal fired power plant without substantial changes to the combustion process. Technologies such as membrane separation, the conventional temperature swing adsorption (TSA) or pressure swing adsorption (PSA) have been proposed to capture CO_2 from flue gases. The disadvantage of TSA and PSA is high energy consumption since TSA requires high regeneration time while PSA need cooling and drying system for flue gas. Adsorption technique has been considered to be most effective and cost benefits for industries and for this technique AC is utilised .Adsorption is done by physical and chemical method [1].

One of the other technique is reducing CO_2 level in biogas that can increase the calorific value to produce energy. This technique includes physical and chemical adsorption, pressure swing adsorption, cryogenic separation, membrane separation, biological-chemical CO_2 fixation and absorption. The dense adsorbents that can purify biogas is zeolite, its structure can be used for the adsorption of other GHGs except methane. The adsorption ability of zeolite for this exhaust gases is about 25% [10]. Further natural zeolite based adsorbent pellets were designed to remove the CO_2 content in biogas [2]. Reason behind this technique is to reduce CO_2 which is produced from biogas into the atmosphere. Contingentally, adsorption represents an attractive remediation technology widely used for the treatment of gaseous and liquid effluents due to its high operating flexiblility and general low cost effective which is done for flue gas [1] [2]. According to chemical aspects continous adsorption is studied from flue gas stream system performed in a fixed bed adsorber which is lab-scale plant [3].

Rapid utilisation of adsorption process in presence of AC will reduce CO_2 from atmosphere because it has porous carbon material with large adsorption capacity for CO_2 . However, comparison of activation of bio-char on the adsorption of CO_2 has not been studied before. Steam,CO_2 and KOH were used as activation components for activation of bio-char obtained from pyrolysis if whitewood. In this study, the CO_2 adsorption was performed at atmospheric pressure, temperature range of 20-60°C and CO_2 range of 10-30 mol% and the influenced of activation method, porous structure, surface area and surface chemistry on performance of the adsorbents were examined. Adsorption capacity was interpretated by using breakthrough curve in an isothermal fixed-bed reactor and the bed adsorption capacity was analysed as a function of both breakthrough time and the S shape of the breakthrough curve under systematic operating conditions. This model shows the capacity of agents for adsorption of CO_2 at atmospheric pressure and temperature range [4].

RESULTS

1. HYDROTHERMAL TREATMENT

AC is treated with metal nitrate of an appropriate concentration to obtain around 12 wt% of metal content per gram of AC. Further 240 mL of 12 wt% metal solution 1g and 24g of AC are mixed at 200˚C in the autoclave for 20 min [11]. The autoclave was then cooled to room temperature and the samples was collected and dried at 60˚C for 24 hours. The sample was then blazed at 450˚C for 1 hour under the flow of nitrogen (N_2) [1]. A commercial AC was utilised as a adsorbent. High purity commercial powder metal nitrates, copper nitrate (Cu (NO3)2·3H2O) and cerium nitrate (Ce (NO3)3·6H2O) were used as metal oxide precursor to modify AC are material required for treatment.

1.1. WET IMPREGNATION

AC was impregnated with metal nitrate of 12 wt% metals loading. During the impregnation, the solutions of metal nitrate were continuously mixed with AC for 5hr. Then the samples were heated to 60˚C while being constantly stirred until the liquid was totally evaporated. After that the samples were dried in an oven at 60˚C for a period of 24 hr. Finally, the prepared samples were heat-treated at 450˚C for 1 hour in the presence of nitrogen to form the reduced sorbents [12] [13]. Table 1 shows the naming of the samples prepared by both methods.

TABLE 1.The naming of the samples

Metal Loaded/method	Hydrothermal treatment	Wet impregnation
Copper, Cu	ACCu-HT	ACCu-WI
Cerium, Ce	ACCe-HT	ACCe-WI
Ce and Cu	ACCeCu-HT	ACCeCu-WI

(a) Hydrothermal treatment: It is another looming WTE technology speacially designed for conversion of wet biomass feedstock with no dependency on energy input, which otherwise is needed for drying of the feedstock in other techniques.

(b) Wet impregnation: It is a commonly used technique for synthesis of heterogeneous catalysts. Typically, the active metal precursor is dissolved in an aqueous or organic solution.

For characterization other techniques like Scanning Electron Microscopy (SEM) and structure or X-ray Diffraction is used for crystalline materials fingerprint and structure examination.

1.3. CO_2 ADSORPTION TEST

The adsorption of CO_2 of the prepared sorbent was carried out in a CO_2 adsorption unit as shown in figure 2. 1gm of the sample was placed in the adsorption unit. A stream of gaseous mixture, containing CO_2 and helium (He), was passed through the prepared samples in the ration of 1:4. The reaction temperature 0f this process was preset to 30`c. The outlet concentrations of CO_2 were measured using a CO_2 gas analyser after sorption activity. The concentration of CO_2 was recorded continuously for every 10s until it reaches the breakthrough point. The activity of the sorbent towards CO_2 is expressed by adsorption capacity, which is defined by the breakthrough curves(C/C0 versus t). C/C0 is a dimensionless factor, where C is the outlet concentration of (ppm) from the reactor, C0 is the initial concentration (ppm) and t is the reaction time (min). Each and every experimental run was repeated at least three times to increase the precision of the results [13].

FIGURE 1.

1.4. CO_2 ADSORPTION TEST

The test was carried out under temperature which was kept constant throughout the experiments at 30°C. The samples were first flown through He to remove the CO present in the adsorption unit. Then, 20% of CO_2 gas was flown through the sample for adsorption analysis. As shown in figure 2 comparisons between the breakthrough curves of raw and modified AC as well as hydrothermal treated and impregnated AC.

Based on breakthrough curves, it was found that ACCe-HT has the highest adsorption capacity of 0.858 mmol/g. This high adsorption capacity may occur due to both physisorption and chemisorptions based on the high surface area and highly dispersed metal. The breakthrough time for ACCe-HT was also high which was 19.36 min. The longer the CO_2 maintain in contact with the sorbents, the better the adsorption [13] ACCeCu-WI has the lowest adsorption capacity and breakthrough time which were 0.119 mmol/g and 9 min respectively. This happened due to the low surface area of sorbent. In consideration of the metal oxides particles have filled up most of pores and cover most of the AC surface, the adsorption occurred completely on chemisorptions and physisorption occur. The results of CO_2 adsorption test for this study were represented in Table 2 with the adsorption studies [1].

2 Table. CO_2 adsorption test

Sample	q(mmol/g)	Breakthrough Time (min)	Source
Raw AC	0.653	19.13	This Study
ACCu-HT	0.587	18.18	
ACCe-HT	0.858	19.35	
ACCeCu-HT	0.562	15.35	
ACCu-WI	0.524	16.85	
ACCe-WI	0.118	10.18	
ACCeCu-WI	0.060	9.01	
AC	0.79	17.05	

According to this study of breakthrough curve and hydrothermal or wet impregnation method it can be determined that metal oxides for adsorption of carbon dioxide performed well adsorption in hydrothermal treatment in presence of AC. The whole process can be performed well further with larger surface area and carbon dioxide molecules reaction with better metal oxides.

.2. Preparation for Carbon Molecular Sieve

Commercial granular activated carbon (GAC) purchased from METRA Co. Ltd. of 10 g was deposited with acetylene by chemical vapour deposition process under 5, 10, 15, and 20 ml/min of acetylene and 50 ml/min of nitrogen flow for 15, 30, 45, and 60 min at 600, 700, 800, and 900 °C. Afterwards, carbon molecular sieve produced from GAC (CMSGAC) was analysed for BET specific surface area and iodine number in order to find out the optimum condition as shown in Table 3. The CMSGAC from each condition was designated as CMSf, t, T where f, t, and T were acetylene flow, time, and temperature, respectively. The commercial carbon molecular sieve (CMSCOM) used in this study was Shirasagi MSC-3K-172 which was purchased from Shirasagi Co. Ltd. [4]

2.1. Adsorption experiment

The GAC, CMSGAC, and CMSCOM were analysed for CO_2 adsorption in a single column as shown in Figure3. The initial chemical compositions of the mixed gas were 30% CO_2, 50% CH_4, and 20% N_2. The mixed gas was fed at controlled pressure of 3 bars with the ratio of flow rate (inlet/outlet) of 1 at 25 °C. To analyse the gas chromatography experiment for carbon dioxide removal were carried on by outlet gas collection at 6-155 min. Further for methane analysis, the concentration of methane was carried at 10 min by collection of outlet gas. Afterwards gas concentration in ratio calculated adsorbent between carbon dioxide and methane.

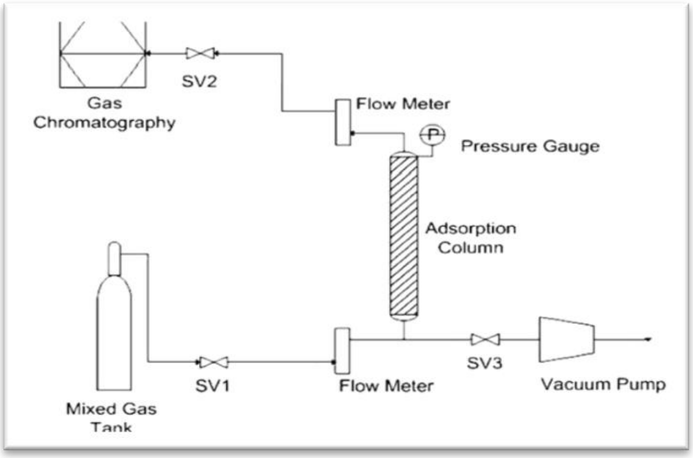


FIGURE 2. Shows Single column system diagram [2].

2.2. Adsorption experiment

Specific Surface Area Studies

Analytical by adsorption and desorption technique with nitrogen gas in GAC, CMSGAC, and CMSCOM in Table 3; show that specific surface area were a 301.11, 603.0, and 558.9 m2/g, respectively while the total pore volume were 0.1649,0.3850, and 0.2531cm3/g and the mean pore diameter were 2.184,2.188, and 2.362 nm, respectively. The optimum condition in chemical vapour deposition process including acetylene flow, time, and temperature were 15 ml/min, 30 min, and 800 °C, respectively.

The results in Table 3 suggested that the chemical vapour deposition by acetylene at optimum condition would increase the specific surface area and the pore volume because macro pore and mesopore in CMSGAC was developed as micro pore which improve the specific surface area and the pore volume [14].

When diffusion of acetylene through the pores is faster than reaction (low temperatures), there are no diffusion limitations and carbon will deposit uniformly over the entire pore surface. If reaction is faster than diffusion (high temperatures), there will be strong pore diffusion limitations, the reactant will not reach the interior pore surface and carbon deposition will occur mainly at the pore entrance [15].

In case of operation on long time and too fast flow of acetylene, the excess reactant will block the entrance of pore surface, so specific surface area and pore volume will clearly decrease [4] .

Iodine Number Studies

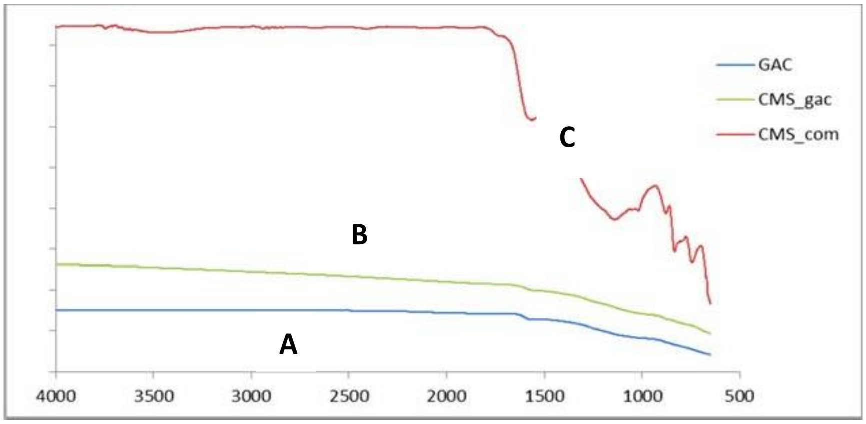
The iodine number of GAC, CMS_{GAC}, and CMS_{COM}, listed in Table 3, were 137.2, 325.3, and 295.4 mg/g, respectively. The results showed that the chemical vapour deposition process could improve iodine number due to the increase of surface area after chemical vapour deposition process.

Table 3. The results of BET specific surface area and iodine number.

Materials	**Surface Area**	**Pore Volume**	**Diameter**	**Iodine number**
	(m^2/g)	**(cm^3/g)**	**(nm)**	**(mg/g)**
*GAC	301.11	0.1649	2.184	137.4
$CMS_{5, 30, 800}$	471.9	0.3533	2.185	243.8
$CMS_{10, 30, 800}$	529.5	0.3587	2.185	263.7
$CMS_{15, 30, 800}$	601.3	0.3699	2.186	322.6
$CMS_{20, 30, 800}$	586.8	0.3616	2.220	301.5
$CMS_{15, 15, 800}$	577.4	0.3634	2.178	293.2
$CMS_{15, 30, 800}$	597.10	0.3704	2.184	318.3
$CMS_{15, 45, 800}$	539.9	0.3579	2.199	287.2
$CMS_{15, 60, 800}$	510.9	0.3540	2.226	279.5
$CMS_{15, 30, 600}$	532.8	0.3694	2.179	267.8
$CMS_{15, 30, 700}$	579.10	0.3716	2.178	279.6
*$CMS_{15, 30, 800}$	604.3	0.3850	2.188	325.4
$CMS_{15, 30, 900}$	489.5	0.2955	2.239	251.4
*CMS_{COM}	588.8	0.2531	2.362	295.5

2.3. Fourier Transform Infrared Spectroscopy Studies

Fourier transform infrared spectroscopy (FTIR) spectrums of GAC, CMSGAC, and CMSCOM are shown in Fig.4. Both GAC and CMSGAC had the same functional groups, such as aromatic (-CC stretch) and carboxyl (-OH stretch). In operation of chemical vapour deposition, functional groups of alcohol-phenol in GAC disappeared while new group such as alkane was found. CMSCOM possessed several functional groups such as alcohol-phenol (-OH stretch), *1°*, *2°* amide (-NH stretch), alkyl halide (-CH2X stretch), and aliphatic amine. Thus, because of the surface area of GAC was covered with many reactants some functional groups disappear in chemical vapour deposition process [4]. **FIGURE 3**.FTIR spectrums of (A) GAC (B) CMSGAC, and (C) CMSCOM mentioned above [4].



3. Experimental Setup for Co_2 removal in biogas using natural zeolite –based adsorbent

Natural zeolite was used as an adsorbent pellet in Biogas experiment. In this study, biogas were prepared with the mixture of air and CO_2 with a content of CO_2 35%-45% (v/v). A supporting material water (H_2O) as a natural adhesive was used to form the zeolite particles into pellets. The experiments were performed in ecology laboratory at the Chemical Engineering Department, University Sumatera Utara. Figure 4. Shows the laboratory scale of adsorption column as a purifier.

Adsorption was conducted in a column with internal diameter of 9.1cm and height of 91cm. The adsorbents were placed in a column that is 45cm high. The column had a manometer and flow metre to measure the column pressure and air-CO_2 mixture flow rate, respectively. Supporting equipment includes air chamber, air supply, CO_2 tank and inline mixer. Inlet and outlet CO_2 concentration of the column was measured by SAZQ biogas analyser, which was manufactured by Beijing Shi'an Technology Instrument Ltd., China.

3.1. Method of adsorption system.

Adsorbents manufacturing

The adsorbents were synthesized in form of various sizes of particles. The particles size variations were 50,100 and 140 mesh, whereas the variations of temperature calcinations were at 200℃, 300℃ and 400℃ for 2 to 4 hours, respectively.

Adsorption

The adsorbents were placed into column for the adsorption process. Mixture of air and CO_2 were mixed into the air chamber until a constant concentration of CO_2 of 40% (v/v) was measured. To increase the mixing process gas was fed into inline mixer. The flow rate of mixed gas varied at 200, 400 and 600 ml/min and experiment was performed for 30 minutes at pressure of 1 atm. The residual CO_2 content of purified gas was analysed every minute by SAZQ biogas analyser and stored in the gas collector. The collected data was used to analyse CO_2 removal efficiency by breakthrough curve [2]. Table 4. Shows different types of pellets that can reduce amount of CO_2 below 10%, and the fig 3 shown below presents the percentage of CO_2 removal from the air-CO_2 mixture for each type of adsorbent pellet with zeolite particle sizes of 50, 100 and 140 mesh at calcinations temperature 400 °C. The surface area of the adsorbent was used to examined the adsorption capacity and amount of adsorption was proportional to its surface area [5], fig 3 represents the effect of pellet size on percentage of CO_2 removal that is the 140-mesh adsorbent pellet could reduce CO_2 content with the highest removal efficiency compared with the 100- and 50-mesh pellets. This phenomenon occurred because the 140-mesh size has a larger surface area than the 50- and 100-mesh sizes.

Table 4. Types of adsorbent, which can reduce CO_2 amount below 10%.

Adsorbent types	**Initial CO_2 concentration (% v/v)**	**Final CO_2 concentration (% v/v)**	**Removal efficiency (%)**
A	40	4	92.51
B	40	6	87.51
C	40	7	85.02
D	40	7	85.02
E	40	8	82.51
F	40	11	75.02

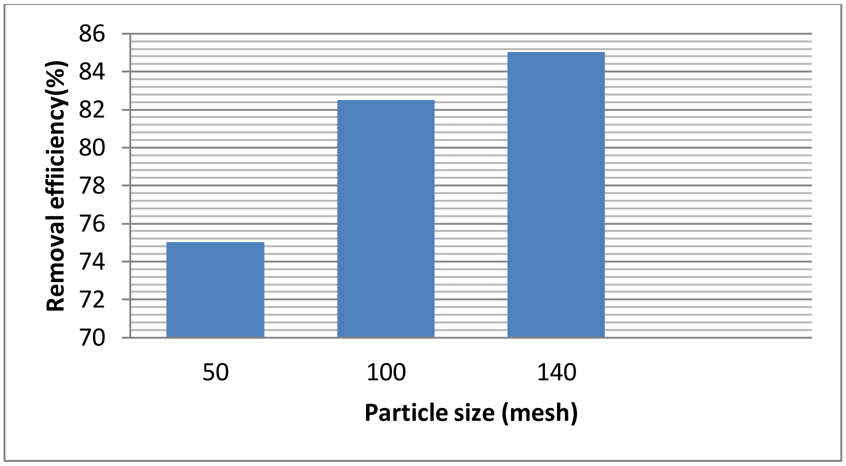


FIGURE 4. Effect of pellet particles size on percentage of adsorption and removal of CO_2

3.2. Breakthrough curve data of CO_2 removal by various pellets adsorbent.

The breakthrough curve data of CO_2 removal is used to determine the breakthrough time and adsorption capacity [6]. Figure 7 shows the breakthrough curve of CO_2 removal by various types of pellet adsorbent at the flow rate of 200 ml/min. From the breakthrough curve of adsorption pellet the capacity of adsorption can be analysis. If the ratio value of initial and final CO_2 concentration approach to one (Ct/Co = 1), then the adsorbent becomes saturated, and the adsorption becomes abortive. This experiment aimed to obtain the adsorption capacity from six types of adsorbent at air-CO_2 mixture with flow rate of 200 ml/min. The optimum adsorbent type obtained was used again at different flow rates at 400 and 600 ml/min. Figure 6 the highest adsorption capacity of 0.09238 mmol/g was determined for adsorbent particle pellet type A with 16.9 min got highest breakthrough curve.

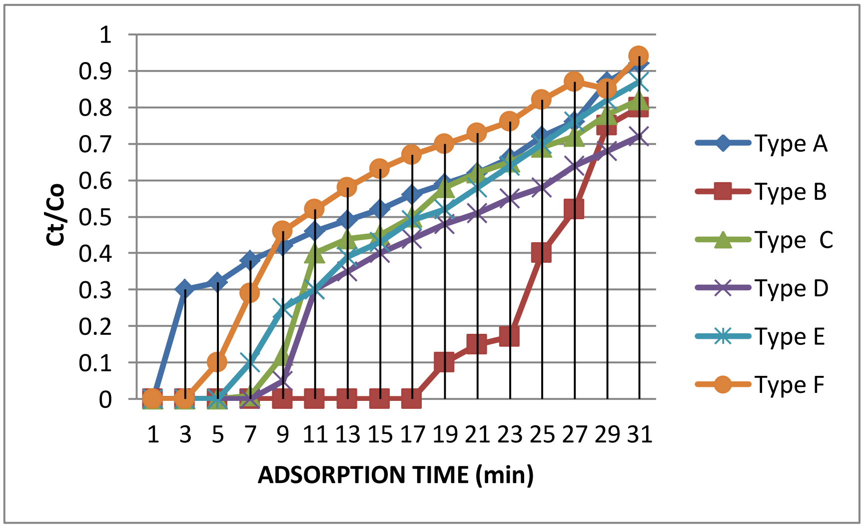


FIGURE 5. Carbon dioxide removal breakthrough curve.

4. Adsorbents and characterization techniques for performance of AC with different textural properties.

In order to assess the effect of different porosimetric structures on CO_2 capture performance two AC were selected for the experiment: Calgon Carbon Filtrasorb 400(particles size 600-900µm, sample F600-900) and Mead Westvaco Nuchar RGC30 (particle size 600-1000µm, sample N.RGC30). Porosimetric analyses for selected adsorbents was carried out in an N2Gsorb-6 porosimeter, work at 77 K and 273K for N_2+CO_2, respectively. BET equation was applied in to nitrate for the apparent surface area. The total micro pore volume(V0) was obtained from N_2 adsorption data using the Dubinin-Radushkevich (DR) equation, while the mesopore volume (Vmeso) was deduced as the difference between the total pore volume (Vt), corresponding to the amount adsorbed at P/P0=0.97, and V0. Finally, the volume of narrow micro pores (Vn, pore width up to 0.7nm) was evaluated from CO_2 adsorption isotherm at 273 K using the equation of DR [7] [3].

4.1. Lab-scale plant and adsorption experiments.

Fixed-bed column was used to perform adsorption tests on the selected AC in a lab-scale plant. The fixed-bed temperature was controlled by means of ad hoc heating system, it consist of three 500 W cylindrical shell band heaters, which was arranged coaxially with the absorber unit and wrapped in a thermal insulating layer of ceramic fibres. This feed gas composition (N_2+CO_2) was controlled with the use of two mass flow controls. CO_2 concentration was measured by a continuous NDIR (non-dispersive infrared) gas analyser. Lastly, by interfacing the analyser with a PC unit via LabView™software, data accession and augmentation were performed. CO_2 adsorption tests were performed under 303K and 1atm total gas pressure. CO_2 dynamic adsorption data were processed to obtain the corresponding equilibrium CO_2amount captured on each solid (ωeq, mol kg-1), through a material balance on CO_2 over the entire fixed-bed column. It is underlined that for N.RGC30 adsorbent experiments were conducted using a lower solid amount because of its lower density (13 g of solid completely filled the column) [3].

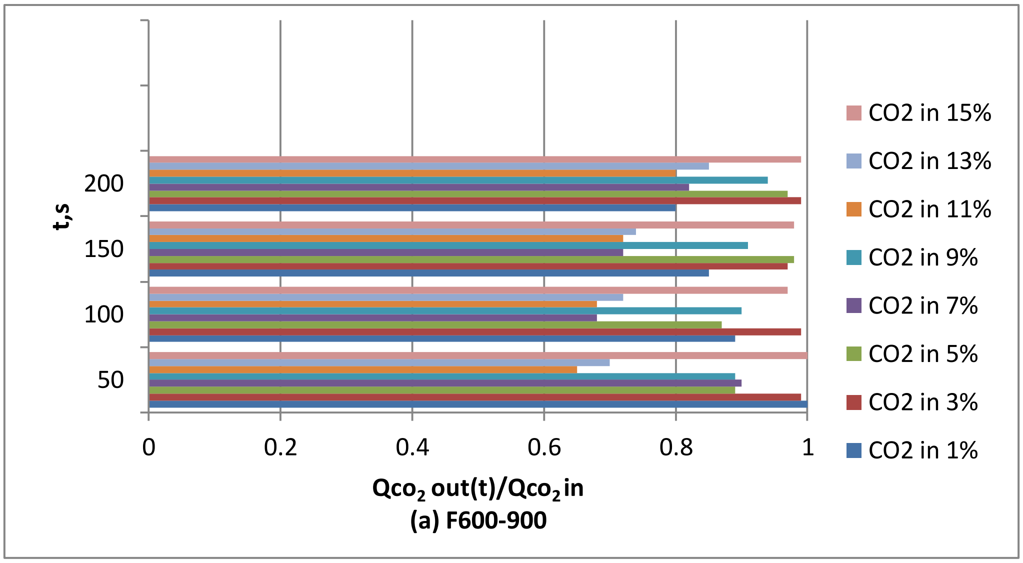
Table 5. Result of AC micro structural properties (Main parameters of F600-900 and N.RGC30 samples).

	F600-900	N.RGC30
Vt, cm3 g-1	0.60	1.17
V0, cm3 g-1	0.43	0.52
Vn, cm3 g-1	0.34	0.34
Vmeso, cm^3 g^{-1}	0.19	0.67
SBET, m^2 g^{-1}	1078	1429

Moreover, N.RGC30 is characterized by a broader micro pore size distribution with wider micro pores compared to F600-900, as confirmed by the higher difference between V_0 and V_n values [8], and it displays a remarkably higher contribution of mesopores (V_{meso} is nearly fourfold the value obtained for F600-900) [3].

4.3. Performance for adsorption of CO_2 by AC with different textural properties.

For study breakthrough curve through bar graph was determined with source of data for (a) F600-900 and (b) N.RGC30 as a function of the inlet concentration at 303 K. According to general study, it can be examined that for each adsorbent the breakthrough curve show lower



(a) F600-900

Break points time t and higher slope of the linear part of the sigmoid as the CO_2 initial concentration increases. This pattern of curves can be occurred because of an increase in adsorption rate observed at higher process driving force [9]. Figure 8 depicts the breakthrough curves obtained for F600 and N.RGC30 as a function of CO_2 concentration in the feed [3]. A comparison of the dynamic performances of the two adsorbents can be done by introducing a time parameter delta torque=t0.9−tb which is related to the slope of the linear part of the sigmoid: The smaller this parameter the breakthrough curve will be higher and consequently, the adsorption kinetics can be faster. Delta torque values obtained from kinetic profiles are generally smaller for N.RGC30.

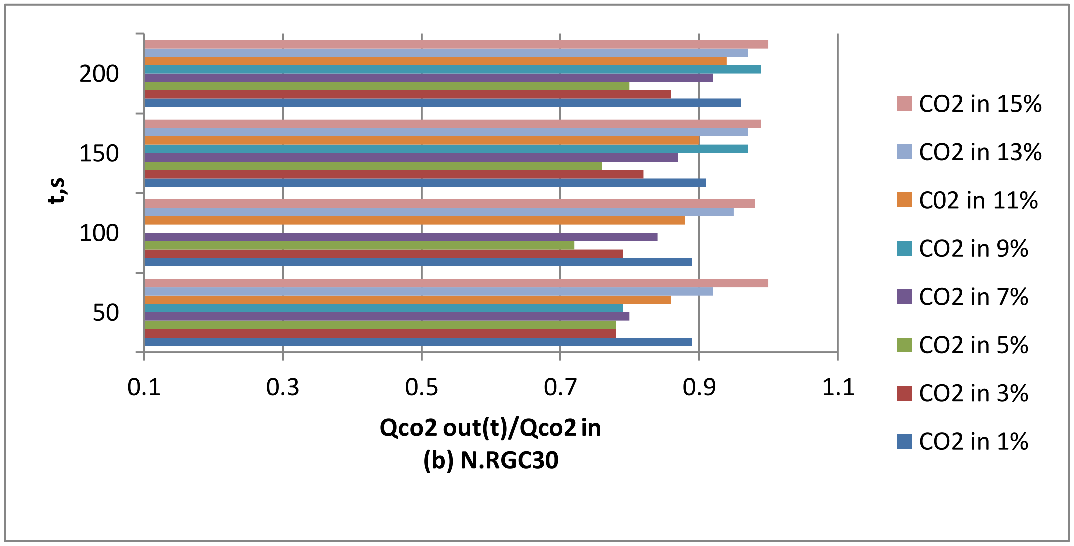


FIGURE 6. Study of breakthrough curve with bar graph for determination of (a) F600-900 and (b) N.RGC30 the CO_2 inlet concentration at 303 K in term of function.

On the basis of the adsorbents textural properties reported in Table 5 one would have expected higher CO_2 adsorption capacity for N.RGC30 sample because of its higher surface area and micro pore volume. Nevertheless, as recently highlighted by Wahby et al. [7], the presence of a narrow micro pore size distribution with well-defined pore size entrances (mainly pore diameters<5 Å) seems to be a key factor in determining CO_2 adsorption, because in narrow micro pores the overlapping potential produces a more effective packing of CO_2 molecules. As a consequence, the narrower micro pore size distribution with smaller pore widths observed for F600-900 solid should be responsible for its higher CO_2 adsorption capacity[3].

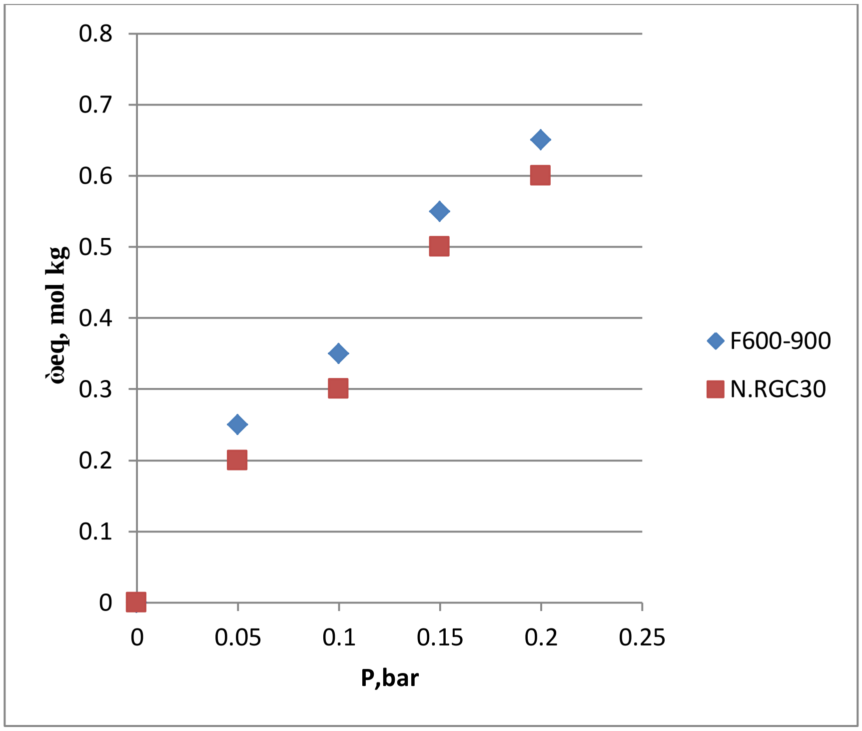


FIGURE 7. Represents CO2 adsorption isotherms at 303 K for F600-900 and N.RGC30 adsorbents obtained by processing dynamic data determined in FIGURE 8.

DISCUSSION

The study of CO2 adsorption on AC hydrothermal treated and impregnated with metal oxides has determined the hydrothermal treatment provides better adsorption of CO2 as compare to wet impregnation because of its high OFG content that develop higher surface area and pore size of the AC. This AC hydrothermal treatment with metal oxides may be better adsorbent for CO2 capture and large surface area is mostly important in gas adsorption.

The chemical vapour deposition (CVD) of carbon molecular sieve was prepared from activated carbon (CMSGAC) using acetylene at various conditions, such as acetylene flow rate, time and temperature. This experiment represents that CMSGAC had higher adsorption quality and high selectivity for adsorption between carbon dioxide and other GHG's ratio. Further FTIR study shows certain functional group alcohol-phenol, amide, alkyl halide, aliphatic amine disappear in CVD process due to surface area of GAC was coated with reactant. GAC and CMSGAC had same functional groups this made certain functional groups to disappear in CVD process. The CVD process could improve iodine number due to increase of surface area after deposition. Hence, CVD process can increase the carbon adsorption efficiency and able to capture higher CO2 from air or system.

Natural zeolite-based adsorbent pellets and other adsorbent pellets can be improving more for the further high adsorption of carbon dioxide. The best type of zeolite pellet used as adsorbent was of particle size 140 mesh and calcination temperature 400℃ for 4 hours, where the CO_2 removal efficiency reached 92.7% at flow rate of 200 ml/min. The best adsorption capacity was 0.118 mmol/g by using pellet adsorbent with 140 mesh size, calcinations temperature 400 °C for 4 hours and flow rate of 400 ml/min with a breakthrough time of 10.7 min [2]. This study shows the adsorption and removal of CO_2 in biogas using natural zeolite-based adsorbent.

CO2 adsorption onto two commercial AC F600-900 and N.RGC30 was examined at 303 K under flue-gas model condition in a fixed bed column. Further it shows the main role of mesopores and wider micropores in determining a faster adsorption process for N.RGC30 AC. After long time it conclude ,the presence of a narrower micropore size distribution with smaller pore widths observed for F600-900 solid was studied to be main factor in developing better CO2 removal performances under equilibrium conditions with respect to N.RGC30 [3].

CONCLUSION

The CO_2 adsorption and removal performance of hydrothermal treatment process, chemical vapour deposition (CVD) process, natural zeolite-based adsorbents pellet and performance of two commercial AC F600-900 and N.GRC30 for carbon dioxide adsorption were examined under temperature, time and flow rate. Adsorption results demonstrated that adsorption capacity depends on particle size, functional group, surface area of adsorbents and on better quality of adsorbent pellets. The two commercial activated carbon can influence the adsorption process by increasing wider micropores on the surface area of AC which adsorbes and captures CO_2 in higher efficiency. Natural zeolite-based adsorbents pellets can perform high carbon dioxide adsorption process in presence of different types of adsorbent pellets at particular flow rate and temperature which further be improved for better carbon dioxide adsorption and removal in biogas. CVD process represents N.GRC30 better commercial AC for adsorption of CO_2 as its can disappear certain functional groups and develop CO_2 adsorption efficiency from air. And hydrothermal treatment with metal oxides increases surface area of adsorbent which can adsorb CO_2 in higher level. Hence, this processes can be used at better level and has most significant factor for CO_2 adsorption and removal from air with additional treatments.

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