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Full Length Article

Virgin coconut oil (VCO) and potassium glycinate (PG) mixture as absorbent for carbon dioxide capture

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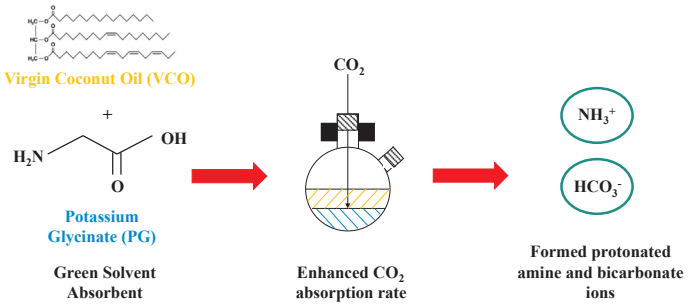
GRAPHICAL ABSTRACT



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ABSTRACT

In this work, the performance of potassium glycinate (PG) and virgin coconut oil (VCO) mixture as potential green solvent for carbon dioxide (CO_2) capture was investigated. The mixture was prepared by mixing PG with 50 weight percent (w/w%) VCO and characterised using density meter, tensiometer and Fourier Transform Infrared (FT-IR) spectrometer. The densities of PG, VCO and PG-VCO mixtures measured from 303.15 to 333.15 K were fitted against an empirical correlation. Viscosities of pure VCO and PG-VCO mixtures were measured at 308.15 K. The solubility of absorbents were studied by bubbling CO_2 directly into the solution and measuring mass increase of the solution. Experimental results showed that the density of PG, VCO, and PG-VCO mixtures decreased with increase in temperature and increased with increase in PG concentration. On the other hand, the viscosity of PG-VCO mixtures were reduced by approximately half compared to pure VCO. Moreover, the addition of VCO into the PG solution enhanced the solubility of CO_2 in the mixture due to the additional physical interaction between VCO and CO_2 molecules. Maximum CO_2 absorption of 3.942 mol CO_2/mol of PG was observed for 0.1 M PG-VCO mixture. A mechanism study also revealed that the presence of VCO contributed to the formation of bicarbonate ion and protonated potassium glycinate after the CO_2 absorption.

1. Introduction

In recent years, intense heat wave is a common phenomenon observed across the globe. Excessive emission of carbon dioxide (CO_2) was identified as one of the major contributors of global warming. It was reported that the global warming rate increased by 37% from the year 1990 to 2015 due to the presence of greenhouse gases (GHGs) in the atmosphere [1]. CO_2 alone accounted for approximately 30% of the

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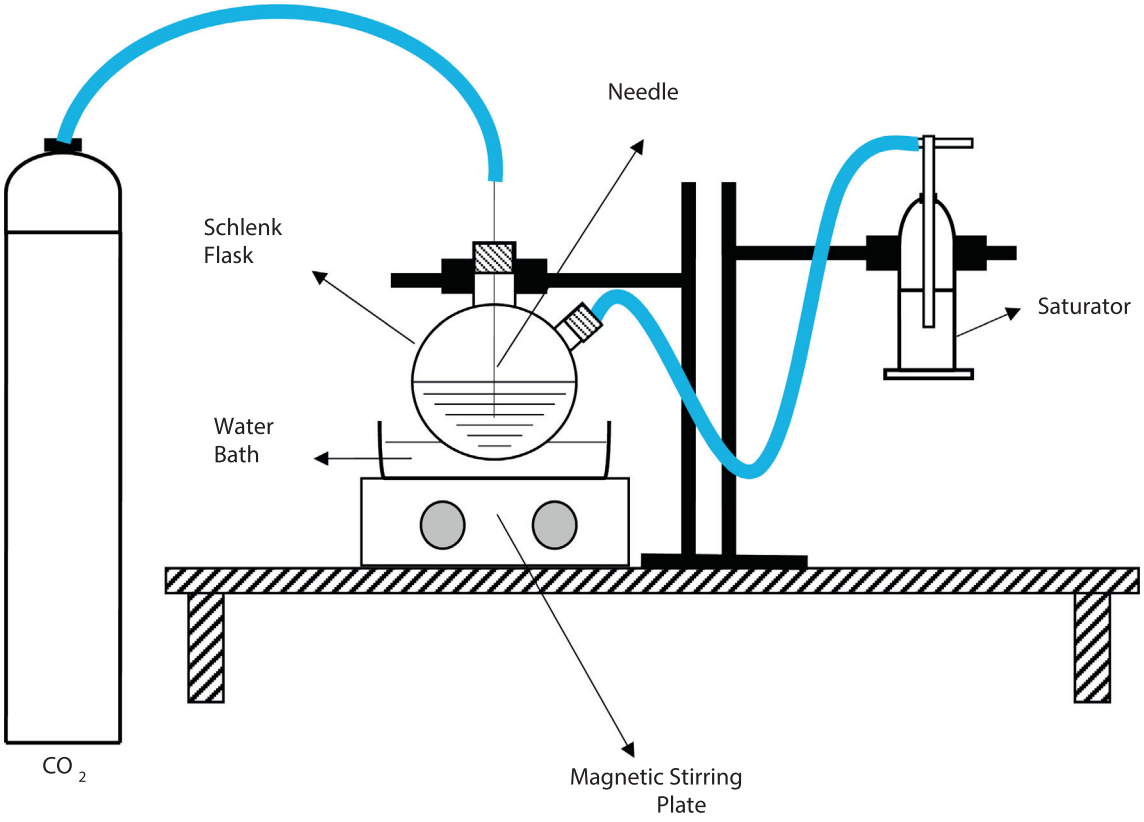

Fig. 1. Experimental set-up for CO_2 absorption study.

Table 1
Comparison of experimental density of deionized water with literature [43].

Temperature (T)	ρ_{exp} (g/cm^3)	ρ_{lit} (g/cm^3) [41]	AAD (%)
298.15	0.99704	0.99696	0.020
303.15	0.99564	0.99587	
308.15	0.99402	0.99425	
313.15	0.99221	0.99243	
318.15	0.99020	0.99043	
323.15	0.98803	0.98826	

Table 2
Fitting parameters based on Eq. (2).

Sample	Composition	A ($\times 10^4$)	B	σ	R^2
1	0.1 M PG	−4.199	1.129	3.446×10^{-4}	0.9952
2	0.1 M PG + VCO	−6.010	1.147	4.399×10^{-4}	0.9962
3	1.0 M PG	−4.571	1.188	2.623×10^{-4}	0.9976
4	1.0 M PG + VCO	−4.321	1.127	1.400×10^{-3}	0.9301
5	3 M PG	−5.066	1.289	1.630×10^{-4}	0.9993
6	3 M PG + VCO	−4.272	1.147	9.785×10^{-4}	0.9641
7	VCO	−7.097	1.130	2.280×10^{-5}	1.0000

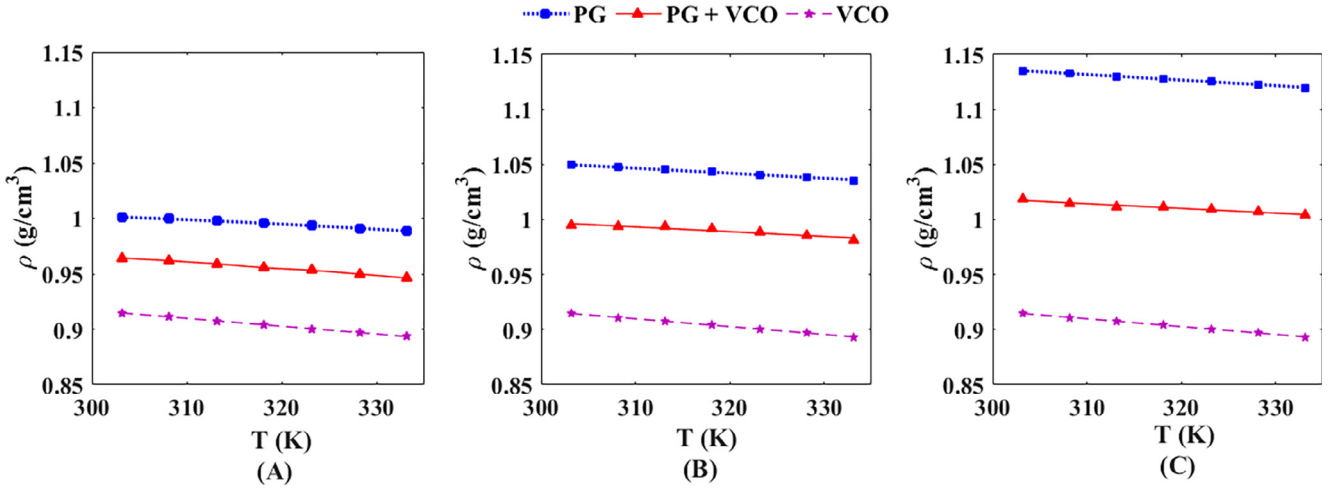

Fig. 2. Densities (ρ) of absorbents at temperature of 303.15 to 333.15 K for potassium glycinate (PG), virgin coconut oil (VCO) and PG-VCO mixture for 0.1 M PG (A), 1.0 M PG (B), and 3.0 M PG (C).