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Preface

The emission of CO_2 into the atmosphere is assumed greatest adverse impact on the observed green house effect causing approximately 55% of the global warming [1]. The climate change stemming from the rise in atmospheric concentrations of Green House Gases is emerging as a growing risk globally. The impact of such climate change is well known. As a result, various research and development projects have been taken up world wide on CO_2 capture economically. Given the 30% of the total global fossil fuel used for power generation that emits considerable amount of CO_2, the thrust on the researches of CO_2 absorption is being imparted to the flue gas containing CO_2 emitted from the fossil fuelled thermal power plants (TPPs). An estimate suggests [2] that burning fossil fuels emits around 6 billion tons of carbon globally in which about 1.8 billion tons is contributed from TPPs alone. In this light, different end-of-pipe treatment methods have evolved to capture and recover CO_2 economically from the flue gas streams at these facilities so as to minimize the anthropogenic contribution to global warming. These methods are gas–liquid absorption, adsorption, cryogenic separation, membrane separation, biological fixation and oxyfuel combustion with CO_2 recycling [3–5]. The method of absorption using generic amines as absorbents are being commercially adopted since early part of the last century especially for the separation of H_2S and CO_2 in the hydrocarbon industry and thus this has been the subject of extensive study for reducing CO_2 emission from fossil fuel fired TPPs now-a-days. However, advancements with other methods are also being investigated for commercialization.

The recently concluded Conference of the Parties at its 17th session (COP 17) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Durban, South Africa during 28 November to 9 December 2011 has adopted [6] the rapid and time-bound implementation of the quantified emission limitation, and the reduction objectives of Annex I Parties including at least 40–50% below 1990 levels by 2020 under the Kyoto Protocol and commitments by Parties which are not Parties to the Kyoto Protocol. As a group, developing countries should achieve a substantial deviation below the currently predicted emissions growth rate in the order of 15–30% by 2020 respecting the principle of common but differentiated responsibilities and respective capabilities, while acknowledging that such deviation is directly related to the level of support provided by developed countries.

In this special issue on *CO_2 Capture and Storage* current technological advancements and the future opportunities are elucidated. The excellent research articles presented in this issue covers various aspects of CO_2 capture and storage. In the first article, *Wan and his coauthors* have carried out the bibliometric analysis on CO_2 reduction research trends during 1999–2009. They reported that a total of 3177 authors from 56 different countries wrote 855 articles published in 355 journals in 102 subject categories. Of these, the most titles were found in Abstracts of Papers of the American Chemical Society (3.9%). *Muraleedharan and his coauthors* have presented the physicochemical properties of aqueous blends of 2-amino-2-hydroxymethyl-1,3-propanediol (AHPD) and monoethanolamine (MEA) over the temperature range from 293 to 323 K and the absorption of CO_2 into these blended amines at 303, 313, and 323 K. The CO_2 flux into the aqueous blends increased with the increase in temperature while it decreased when the concentration of AHPD increased in the blends. *Yokoyama* has analyzed reboiler heat duty for CO_2 capture in MEA using equilibrium staged model. The overall performance of the process in terms of CO_2 removal efficiency was examined experimentally as a function of various process parameters. The reaction between CO_2 with MEA was addressed based on CO_2–H_2O–MEA equilibrium. It was further shown that the heat of reaction was not sufficient to reduce the reboiler heat duty and other heat components must be taken into consideration to reduce the reboiler heat duty. *Bandyopadhyay and Biswas* presented CO_2 capture using dilute NaOH solution in a spray column using a two-phase critical flow atomizer capable of producing very fine sprays with high degree of uniformity and moving at very high velocities. The maximum percentage removal of CO_2 reported was about 99.96% for a Q_L/Q_G ratio of 6.0 m^3/1000 ACM and for a CO_2 feed rate of 100 l/h, while the values of interfacial area reported were in the range of 22.62–88.35 m^2/m^3. The range of interfacial area reported was higher than the existing systems and thus the performance was better than the existing system. *Kundu and his coauthors* have used a novel gas–liquid contactor for improving the chemisorption of CO_2. It was based on the absorption of CO_2 during its rise as axi-symmetric bullet shaped Taylor bubbles through millichannel. The influences of various operating parameters were investigated on percent absorption of CO_2 and CO_2 loading. It was reported that the CO_2 removal and CO_2 loading increased while absorption rate decreased with decrease of pipe diameter. This information could be exploited for optimizing the input parameters to maximize the efficiency of CO_2 removal. *Mishra and his coauthors* have investigated on the gas adsorption properties of CO_2, CO, CH_4 and N_2 on a zinc based metal organic framework more commonly known as ZnDABCO. Equilibrium adsorption isotherms for these gases were measured up to 26 bar at different temperatures. The isotherms were modeled using modified virial equation. Ideal Adsorbed Solution Theory (IAST) was used to predict selectivity of binary mixtures. *Aeshala and his coauthors* have reported on the electrochemical reduction of CO_2 in a reactor using different solid polymer electrolytes. They developed and used cationic as well as anionic solid polymer electrolytes. On the other hand, cathode used was electrodeposited copper on porous carbon paper while

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Pt/C on the carbon paper was used as anode. The products formed after the electro-chemical reduction of CO_2 were mainly formic acid, methanol, formaldehyde, carbon monoxide, and methane apart from the undesired hydrogen gas as a by-product. *Li and Liang* reports a case study of an existing 1 GW ultra-supercritical power plant in Shandong, China on modeling of CO_2 capture for pulverised coal-fired power plant using ASPEN simulation model. The energy output penalty at different levels of capture was estimated in the retrofitted system. The results of simulation showed that the efficiency penalty was approximately 8.6% for a 90% capture rate and 6% for a 50% capture rate. The economic model revealed that the value of retrofitting option in the study power plant reached US$76 million. Based on the economic model described, the need for developing a guideline to maintain the retrofitting options for the power plants was recommended. *Hsu and his coauthors* have presented an analytic network process (ANP) approach for the selection of potential sites for CO_2 geological storage as a basis for further exploring geological features and simulation of transport characteristics. The site selection in this study was considered as a complex multicriteria decision-making problem, and thus a multi-criteria decision model with eight evaluation criteria was proposed. ANP was applied to site selection and was characterized by interdependencies among decision structure components. An illustrative example in the geological field of oil and gas reservoirs in Taiwan was presented to demonstrate ways to select and rank the most appropriate site in terms of storage capability. The results obtained in this study have proven that ANP-based approach could be a useful tool in enabling decision-makers to facilitate CO_2 storage within climate policy. In the concluding article, *Chen and Shu* have presented CO_2 reduction for a low-carbon community through the city perspective in Taiwan. Taiwan is not a signatory nation to the Kyoto Protocols, and thus there is no legal binding to obey the regulations on CO_2 reduction. However, the total generation of GHGs by Taiwan represents 1% of the global GHG emission, and with respect to the responsibilities of members of the so-called "Global Village" and the restrictions of the international contract, it is prudent to consider and develop measures for GHG reduction. The Tainan city government has thus taken a series of GHG emission reduction measures, which include pushing outreach activities on energy conservation and CO_2 reduction. As a result, the carbon emissions have reduced annually to 56.1% and 96.0%, respectively, at departmental stores and energy-conserving light sources at Ta-Tien-Hou temple.

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