



Physiochemical Absorption: A Carbon Sequestration Technology for Carbon Capture

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DESCRIPTION

The constant rise in gaseous emissions is a serious environmental problem that affects both our planet and the entire human population. The atmospheric release of CO₂, CH₄, chlorofluorocarbons (CFCs), O₃, and NO_x leads to climate change and global warming. When assessed on the basis of unit mass, the greenhouse gas contributions of methane and chlorofluorocarbons are significantly higher than those of CO₂. Nonetheless, the majority of the efforts to counteract the threat of greenhouse gases are focused on CO₂ collection technology since fossil fuels, which account for 98% of the world's energy needs, produce CO₂. Fossil fuel reserves have increased as a result, and the world's energy needs have changed quickly, forcing some current facilities to expand globally and new ones to be built to increase production capacities as a preventative measure to absorb the global energy shocks. Due to the current state of industrial development and economic expansion in many regions of the world, particularly in the developed nations, this situation has continued into future years. Oxy-, pre-, and post-combustion CO₂ capture are the three methodologies used to capture CO₂ emissions from fossil fuel-powered facilities. In precombustion capture, the petrol from the parent mixture is captured before it burns.

Oxy-combustion capture is the process of capturing CO₂ while burning gas in the air, or during combustion. In a downstream unit of the plant that has been retrofitted with a carbon capture system the gas is captured from flue gas (a mixture of elements such as nitrogen, water vapour, and oxygen) during postcombustion capture. Low CO₂ partial pressure, high flue gas temperature, and a high CO₂ content in the flue gas are all difficulties with this procedure. This further supports the claim that coal-fired power facilities are among the major fixed point sources of CO₂ emissions. Ionic liquids, Rectisol, Fluorinated Solvents, and Selexol, also using solvents with a high affinity for carbonaceous substances such as methanol, propylene carbonate, dimethyl ethers of polyethylene glycol, fluorinated solvents, and most recently, ionic liquids—in a reversible or irreversible manner is necessary for physical absorption. Due to their inherent qualities, such as low volatility, high CO₂ solubility, thermal stability,

and susceptibility to structural tuning that enables the attainment of certain advantageous properties, Ionic Liquids (ILs), which are liquid salts of cations and anions, have boiling points of less than 100°C and the capacity to trap CO₂ from a mixture of gases. The degree of CO₂ solubility, selectivity, and IL performance as well as their thermal/chemical stability, have all been examined in several IL investigations.

Task-Specific ILs (TSILs) or amine-modified ILs have been used more extensively and have demonstrated to have a high affinity for CO₂. The high viscosity of the fluids following CO₂ entrainment during gas separation procedures is a recurrent difficulty connected with the usage of TSILs/ILs, despite the literature documenting some important advancement in the creation of low-viscosity ILs. Rectisol is a different solvent trapping method for CO₂ capture. Cold methanol is used in the Rectisol method to capture CO₂ and other acidic gases from polluted gas streams. Whereas the Selexol method uses dimethyl ethers of polyethylene glycol to trap CO₂ at pressures ranging from 2.07 to 13.8 MPa, the Fluor process uses propylene carbonate (C₄H₆O₃) and CO₂ partial pressure to remove CO₂.

Purisol, Rectisol, Selexol, and other similar products are frequently used in the oil and gas sector and are frequently chosen over chemical solvents under high acid gas partial pressures. The proper solvent for natural gas sweetening must be chosen carefully based on the product specifications as well as variables such the gas composition, temperature, and partial pressure of the gas. Aqueous amines may absorb acid gases from natural gas under a variety of circumstances, but they still have several significant drawbacks, such as high energy expenditures for solvent regeneration, poor CO₂/H₂S selectivity, corrosivity, and high volatility. Yet, this prompted a demand for more practical substitutes, which in turn helped to bring in the era of ionic liquids. Ions and anions that make up the polar ends of ionic liquids, including monomeric and polymeric materials have chemical and molecular structures that determine their absorptive potentials. Low vapour pressures, nonflammability, chemical and thermal stability, tunable polarity, dependable electrolytic qualities, and simplicity of recycling are the main characteristics of ILs.

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