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EDITORIAL

GHG Emissions and Role of Polymeric Materials in Mitigation

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GHG emissions of methane (CH_4) have double, and CO_2 are close to double compared to pre-industrial levels. GHG emission mitigation is possible by avoiding their generation, or by emission mitigation technologies. CO_2 can be stored/fixed in minerals, rocks, EOR, underground formations, chemicals, and polymeric materials and many more. Polymeric materials also play role in GHG mitigation, and more focus is required on this aspect. CO_2 consumption during polymerization reactions and plasticization is required to be enhanced. This fact also supports higher polymers production and increasing capacity of polymers producing industries.

Greenhouse gas emissions escalade/broke out/sparked in modern era especially CO_2 peaks at 414 ppm (2021) from 280 ppm (1750) (going to double Soon) and caused recent extreme weather patterns, threatening flooding, heat waves, glaciers lakes melting, extended summer, extreme temperatures (54 °C middle east) [1], droughts, descending water levels, oceans pollution and fresh and wastewater pH variation are warning signs of GHG emissions and anthropogenic CO_2 emissions. There are many Climate change mitigation technologies [1], however, steps/actions

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need to be taken at individual level. Recently, "Green Campus Initiative" is taken at UET (New Campus) where all barren land is converted into greenery by planting multiple crops. Other universities and institutes have implemented GHG emissions analyses and release estimation [2]. However, GHG and especially CO_2 is released significantly when remains of crops are burned. Particulate matter and dust from these burnings and mist, fog and smog generated rise more environmental concerns. These remains of crops may be cut into pieces instead of burning to avoid emissions. Individual initiatives may be saving trees by hard paper free environment and minimum printing i.e. "Save Trees". Coal burning must be abandoned as it significantly releases CO_2, SO_3, SO_2, NO_3 and NO_2. Similarly, there are significant emissions from brick kilns which must be mitigated using amine solutions. Transportation and forest fires also emit CO_2. In Cop26 conference, delegates from almost 200 countries participated and focus is to limit global warming to 1.5 °C as already temperatures are above 1.1 °C compared to pre-industrial values [3]. Clean energy and renewable energy resources such as hydrogen energy, solar energy, biofuels (e.g. biodiesel), wind energy, biogas, hydro energy, tidal energy, fuel cells, biomass, ocean energy and nuclear energy have become necessity to protect environment. These clean energy resources utilization will avoid harsh stance in GHG emission mitigation technologies also limiting safety concerns on geological storage, EOR, oceanic storage and others. Polymeric materials also play a role in GHG mitigation by consumption of these gases (CO_2). Polymeric and nonpolymeric sorbents (absorbents and adsorbents) are currently employed for CO_2 capture [4]. Organic polymers can store carbon dioxide [5]. These polymeric materials have high CO_2 storage capability and were thermally stable and have more pores. Polymer 5 among 4,5 and 6 showed the highest CO_2 adsorption capacity, surface area, and pore volume [5]. Telmisartan organotin (IV) containing small mesopores are also being used as CO_2 capture media [6]. Dibutyltin (IV) complex (4) was most efficient (7.1 wt% CO_2 uptake) having high surface area and volume. Among 3 polyphosphates, meta phosphate showed 6 wt% CO_2 uptake compared to minimum 4.4 wt% requirement [7]. Polymer 5 showed 14 wt% CO_2 uptake [8]. Schiff base 1 having nitro group has shown 10 wt% CO_2 uptake [9]. PIMs, COFs, PPNs, HCPs, CMPs, PAFs and CTF are modern porous materials for CO_2 Capture [4]. Further research on Schiff bases (especially melamine and nitro groups incorporation), ionic liquids/NOHMs coupling with porous organic polymers (including meta phosphate, benzidine) and activated carbons and MOFs will be key to develop more efficient materials complexes for carbon dioxide storage.

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