Improving indoor air quality by phytoremediation technology
Bahni Ray, Assistant Professor, Department of Mechanical Engineering, IIT Delhi

People spend most of their time indoors where the air is often more polluted than outside because there are additional sources of pollutants and room ventilation system plays a major role. Especially now during the pandemic lockdown situation the time spend in indoor have drastically increased. According to WHO, exposure to smoke from cooking fires causes 3.8 million premature deaths every year. Burning fuels such as dung, wood and coal in inefficient stoves or open hearths produces a variety of health-damaging pollutants, including particulate matter (PM), methane, carbon monoxide, polyaromatic hydrocarbons (PAH) and volatile organic compounds (VOC) which include a range of organic compounds that quickly vaporise at room temperature, such as ethyl acetate and benzene.

From the late nineties scientist has explored the use of plants as bio-filter to reduce indoor air pollution. Specific plants have the potential to reduce pollutants in air, remove carbon dioxide through photosynthesis and help reduce greenhouse gases in the atmosphere. This technology is named as air phytoremediation which has many advantages over the traditional indoor air pollution treatment methods like water scrubbing, electrostatic precipitators, HEPA filters.

Phytoremediation can be employed in abating particulate matters (PMs), volatile organic compounds (VOCs), inorganic compounds, persistent organic pollutants (POPs), and heavy metals (HM). For their life processes plants require intensive gas exchange, during which air contaminants are accumulated on leaf surfaces or absorbed into the tissues. Special leaf features and structures such as leaf folding, hairs, trichomes and wax layers have specific roles in pollutant removal and all favour the accumulation of PM.

One of the first real scale trials to reduce indoor air pollution was carried out with the very good indoor phytoremediation species Dracaena deremensis ‘Janet Craig’. Three and six plants of this variety were placed in office rooms and it turned out that just three plants reduced pollution level by 75% below the threshold level of 100 ppb. While static systems such as pot plants have been found to be ineffective for high-capacity contaminant removal, research indicates that ‘active green walls’, which utilize mechanical assistance to funnel air into the biofilter substrate, improve the air purification efficiency.

Air phytoremediation technique is simple, cheap, and easy to implement and not produce secondary pollution. There is need for more research not only by biologist but also expertise from aerosol science, ventilation and air flow dynamics to understand the interdisciplinary nature of the biochemical process involved. The selection of plants and associated microbes will depend on how they capture specific pollutant. As recommended by researchers that active green walls perform better than potted plants, there is further need to explore the air flow direction and the effect of ventilation system in the indoor environment. That will help to determine the selection of appropriate active green wall depending on the (a) tolerance level of plants to pollutants, (b) the environmental condition of location like temperature, humidity, light intensity, wind speed, (c) plant property like leaf size, thickness, roughness, specific photosynthetic system, (d) the nature of pollutant, and most important (e) the size of the room.